THE
FOUNDRY TRADE JOURNAL
WITH WHICH IS INCORPORATED
THE IRON AND STEEL TRADES JOURNAL.

VOL. 26. Thursday, October 19th, 1922. No. 322.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of
THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Contents.

	PAGE
Presidential Addresses	311
European *v.* American Moulding Machine Practice	312
Semi-Steel	314
Foreign Trade in September	314
Heating Metal Patterns Electrically	315
Correspondence	316
Iron and Steel Production	316
An Apprenticeship Course in Foundry Practice—XIV.	317
The John Surtees Memorial	320
Foundry Cupolas	321
The German Iron and Steel Industry	323
Institution of British Foundrymen	324
What's Wrong with the Foundryman?	328
Iron Ore Crisis in France	328
New England Foundrymen's Association	328
Electric Furnace Operation	329
The Selling Price of Grey Iron Castings	330
Contracts Open	330
The Nitrogenisation of Iron and Steel by Sodium Nitrate	331
Research for Metals Industry	331
Trade Talk	332
Catalogues Received	332
Company News	333
Gazette	333
Personal	333
Deaths	333
More Foundry Papers	333
Iron and Steel Markets	334

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

Institution of British Foundrymen.

PRESIDENT, 1922-1923, Mr. H. L. Reason, M.I.Mech.E., Holloway Head, Birmingham.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: D. Wilkinson, 1,114, Bristol Road, Northfield, Birmingham.
Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.
Scottish: W. H. Bound, 69, Minard Road, Shawlands, Glasgow.
London: V. C. Faulkner, 21, Stanley Gardens, W.11.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: J. M. Meston, 37, Melville Road.
West Ridings of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

Presidential Addresses.

Whilst the education of the foundry youth has been touched upon in most of the presidential addresses delivered to the various branches of the Institution of British Foundrymen at the opening of the session, other important phases have also been dealt with. Mr. Roberts, before the Coventry Branch, made out a strong case for the co-operation of the patternmaker and the foundryman by showing him frequent defects in his work. Mr. Lambert, before the London Branch, by means of practical demonstrations with metallurgical testing apparatus, essayed to dispel the bogey of science for foundrymen.

A new note, savouring of desperation, was struck by one Branch president when dealing with the technical training of foundry youths. He advocated a compulsory system, and even invoked State aid. We have little faith in such a proposition, as anything which is procured at no personal cost and a minimum of effort is valued at its cost price and its energy expended. This is the type of education which Mr. Riddel designates as "spoon fed," and characterises as "reinforcing ignorance." Now the scheme suggested by Mr. H. J. Young in his address before the Newcastle Branch, which involved the examination by the Institution of British Foundrymen and the awarding of certificates on the lines adopted by the Institute of Marine Engineers, presents much of interest. But why not state the inevitable, *id est*, that the future will insist on some form of examination or outside examining body equivalent for membership for the Institution of British Foundrymen such as obtains in other chartered institutions?

Another point emphasised is the publication of a foundry reference handbook. We admit that there is a distinct need for such a book, as there is nothing British on the market which quite supplies the need. We are carefully considering the matter, and, in fact, are already working on the subject. It will obviously take some little time, as many of the essential features are still in a provisional and in some cases chaotic condition. Test-bars are an example of the former and grading by analysis the latter. On its completion an edition will be published annually, and be distributed free to subscribers of THE FOUNDRY TRADE JOURNAL.

Mr. Liardet's apprenticeship scheme has been commended by foundrymen as one of the most comprehensive ever put forward. It has been adopted by the foundry owners of the West Riding of Yorkshire, who are co-operating with the Bradford Technical College. It was very disappointing to hear at last Saturday's meeting of the local branch of the Institution of British Foundrymen that the response was poor. Professor Charnock has arranged a splendid course, and he must not be pessimistic. For years the evening classes held in the metallurgical department of Sheffield University were over-crowded, and we feel sure that once classes are firmly established in the district the boys withholding will be considered "outsiders." They will realise that they are missing not only a chance of better education, but also better jobs. Perhaps the success of the Sheffield metallurgical classes was that once having satisfied the professor as to their knowledge of chemistry either by a short *viva-voce* or by passing a preliminary examination in a course of chemistry for metallurgical students, they could start directly with the courses which bore directly upon their daily occupation. A fair percentage of the lads who took advantage of the opportunities afforded were laboratory boys, many of whom have made good to such an extent that their names are household words in the metallurgical world.

We were pleased to notice that Mr. Haigh, in his address before the Lancashire Branch, confirmed what has already been said previously in this column, that the higher administrative positions in the foundry of the future will be held by highly-trained practical men rather than the purely scientifically-trained man. In other words, the practical man who has acquired a thorough knowledge of the technology of his trade. We consider that Mr. Haigh's most important statement was that when conditions return to normal there will not be any surplus of skilled moulders. This lends an added importance to the recruiting of suitable youths for foundry work. We firmly believe that the foundry possesses excellent prospects for boys who care to rough it in the day time and spend their evenings improving their minds.

European *v.* American Moulding Machine Practice.*

By E. Ronceray,
President, Societe Anonyme des Etablissements Ph. Bonvillian and E. Ronceray, Paris, Choisey-le-Roi.

At the 1921 meeting of the American Foundrymen's Association, Mr. H. Cole Estep, European representative of "The Foundry," gave a short description of moulding-machine construction in Europe. The object of this Paper is to give an opinion from a European on the same subject, but adding thereto a description of innovations made from that time. American foundrymen will thereby learn the European point of view. We take advantage of this occasion to correct some discrepancies and to complete Mr. Cole Estep's description on points which necessitated them.

The Scope of Compressed Air.

One point which strikes an American observer who visits European foundries is the small use made of compressed air as a motive power, and on the other hand the considerable extensions of hydraulic pressure, a factor practically unknown in American foundries. The reasons for this are simple and of prime importance. Compressed air at a pressure of from 60 to 100 lbs. does not allow of the obtaining of high pressures on the moulds, and from this fact one can only use it for the making of small moulds. For such work it is both rapid and practical,† but it is not good from the point of view of pattern drawing. In short, it is incapable of giving steady and controllable movements. Thus allowance is made by means of some intermediate element to obtain a withdrawal of the pattern on precision lines by such means as an oil brake (Tabor)‡ or a specially designed hand starter (Mumford), or by similar means.

Leakages.

The leakages of compressed air into the atmosphere are not troublesome, but for this reason they are neglected, with the result that the power lost through them is often equal or more important than the power actually utilised. A. Wardle says§: "It is important to stop the smallest leakage in the pipe system. A ¼-in. diameter round hole would allow air to 100 lbs. pressure to escape at the rate of 100 cub. ft. per min., and 20 h.p. would be required to enable the compressor to cope with this leakage." However, by its nature, compressed air is not economical, as the average motive power absorbed by each compressed air machine is from 1 to several h.p., and the section of the pipes is from one to several inches.

Water pressure, on the other hand, utilises pressures varying from 750 to 1,500 lbs. per square inch. At these pressures, from eighty to twenty times greater than those of air, the piston sections remain rather small, even for the higher pressures, consequently even for large moulds, sizes of machines and prices can be kept within reasonable limitations. Water at high pressure, at the same time, makes for a low consumption and a high speed of water in the pipes, which can thus be made of very small section.

In a carefully-designed machine the water consumption is very low, and the motive power absorbed is ridiculously small. Thus it is quite usual practice to work twenty moulding machines at full output with a 5-h.p. pump, the mains being copper piping ¾ in. inside dia. and 3-32-in. thick walls. The water lends itself to rapid movements for ramming, to initial slow, and then to the more rapid and steady movements for the pattern drawing. It is quite unnecessary that there should be any complication, and the most diverse movements can be obtained by small dimensioned parts. Any water leakages are troublesome, and they obviously require immediate attention, which tends to eliminate both water and motive power losses. They are easy to avoid, however, by the use of well-made piping and leather or india-rubber joints for the fixed parts, and high-class packings for the movable parts.

Freezing.

The most important inconvenience is freezing in cold weather, but it must be considered with no more importance than it deserves. First of all, a water return pipe and a non-freezing mixture can be used, but all the types of water piping in towns, works, flats, water taps in foundries, hydraulic machinery in sea ports and railway depôts, steel works, etc., show that this inconvenience is a mere talking point. As a matter of fact, the temperature ought never to reach freezing point in foundries, because obviously the sand would freeze, and all work would automatically stop. On the other hand, some new machines are so laid out that all the hydraulic section, including the piping, is underground, which practically precludes any chance of freezing. Compressed air, too, is not completely free from frost troubles, for in the air pipe important condensations take place, and the cooling due to air expansion may transform it into ice.

Hydraulic versus Pneumatic Pressure.

There is little doubt that water pressure shows a definite superiority over compressed air for machine moulding, particularly in countries where coal economy is acute or where motive power is dear. The numerous installations of compressed air in American foundries before the advent of moulding machines, the low price of coal in that country, and the complete absence of a spirit of economy, have alone been the determining causes of the choice of air, though the opinion expressed by Mr. W. Lewis, President of the Tabor Manufacturing Company, is (*) "that water cannot compete with air as a working fluid for foundry use."

The choice of compressed air in England must therefore be considered as an error of judgment when engineers of that country aim at constructing such machines. From this fact it is not difficult to concede that the two countries having the same language and so easy and constant communication by means of the exchange of literature and men to a much larger extent than with the European Continent, often follow the American ideas even though they are not the best.

Amongst British machines, the greater part imitate the American jarring machine. Only a few work by pressure, and are original—that is to say—they are not, more or less, distant copies of American machines. Additionally, they are not described by Mr. H. Cole Estep, because, without doubt, they are, in our days, considered out of date. Amongst those who ram by jarring, some employ a guiding by multiple rams, of which the making appears to be very difficult. We prefer, however, single-ram machines wherein the ram is at the same time the guide.

Thus in England, apart from some old-fashioned, but at the same time well-designed, hand-machines, and some original and little used compressed-air pressure machines, manufacturers have imitated the American jarring machine, and that to a small extent which scarcely justifies the opinion of Mr. Cole Estep, which gave the palm to Great Britain for the construction of moulding machines in Europe.

Throughout the technical Press, and in a few recent books, there will be found constantly stated a false aphorism, that jarring machines "are ideal as far as ramming is concerned."

---

* From a Paper as submitted to the American Foundrymen's Association, but slightly abridged.

† "Machine Moulding," by Wilfred Lewis, President of the Tabor Manufacturing Company, page 28: "It (the Jar Ramming Machine) will not ram small work as quickly as a squeezer or split pattern Machine, and such a jarring Machine for half moulds weighing less than 1,000 lbs. is not often recommended."

‡ "Machine Moulding," by Lewis, page 21: "The Machine draws the pattern by means of a cylinder and plunger, using compressed air on hydraulic oil or water to effect the movements." Page 33: "The power used is compressed air, and this acts upon liquid within the pattern-drawing plungers."

§ Paper delivered before the Birmingham Branch of the I.B.F. Foundry Trade Journal, June 2, 1921, p. 499.

(*) Lecture delivered at the Franklin Institute, May 18, 1911. Mr. Lewis says: "The French machine swinging type of Bonvillian and Ronceray, has a number of attractive features, and is said to be very successful in France, where hydraulic power is more popular than it is here, but the machine has not been so successful on this side of the Atlantic, for the simple reason, no doubt, that water cannot compete with air as a working fluid for foundry use."

To such an aphorism we cannot possibly subscribe and associate ourselves with many American foundrymen with whom we have chatted, especially Mr. W. Lewis, that when pressure ramming is possible, it gives, in the large majority of cases, results superior to the jarring machines. We admit, however, that in a few limited cases the jarring machine can show advantage. It is an established fact and one which is easy of proof that an ordinary mould is better and more quickly rammed by pressure than by jarring.** The fact that the number of pressure machines used in America for small and medium size moulds are in outstanding majority is sufficient proof.

It would be interesting to learn, therefore, why jarring machines are in favour for large moulds in America. Basically, it is solely due to the impossibility to ram large moulds adequately by pressure, on account of the low pressure of the fluid usually employed.

The skill of American engineers has turned to use the dynamic effort produced by the impact of a mass raised by compressed air and falling down on an anvil, in place of the static effort derived from simple air pressure.

The claimed advantages of jar ramming, which are not valueless, but secondary, did not count for anything at the beginning, but they have been appreciated since, and it can safely be asserted that they are as little known as are the troubles associated with the system. The only reason why they have been made at the beginning is that it was impractical to make machines to squeeze large moulds by compressed air.

Mr. E. S. Carman stated* that "Jolt ramming accomplishes the ramming of the mould in a more satisfactory manner than a squeezer machine." With such a statement we cannot possibly agree, for Carman describes at some length the complete process of ramming by jarring, which comprises:—(1) Clamping the box. (2) Jolt ramming. (3) Spreading the sand. (4) Butting off. (5) Striking off.

According to this authority,† jolt ramming is accomplished in 5 to 30 seconds. This time is equal or more to squeezer ramming on any type of machine, but the other four operations are not there necessary. Thus it is not under the heading of speed that the "more satisfactory manner" claimed for jolt-ramming machines can show superiority. What about the quality of work? According to Carman‡ the requisites of ideally-rammed moulds are:—(*a*) Uniformly rammed sand. (*b*) Correct density in various parts of the mould. (*c*) Uniformity of various moulds made from the same pattern.

The sentences which follow explaining that the ramming is the same "over the entire pattern" and that the mould is "of uniform density throughout," are not only manifestly erroneous‡‡ but also contradictory with the curve of ramming shown on page 160 of the same book, in spite of these curves being distinctly wrong.

P. Lohse (Stahl und Eisen) has religiously copied or imitated this curve, because doubtlessly it was in print. It is by such means as this that unsubstantiated platitudes get implanted in students' minds, as unfortunately everybody writes or copies without trying things out for themselves.

We hope to prove by systematic experiments that a basic error exists in the "squeezing" curve. As to that of jolting, it is not 50 per cent. of the pressure at the joint which is applied to the back of the flask, but less than a tenth of one per cent. "sand is so loose that it requires additional ramming."§.

We are far from that ideal ramming claimed very thoughtlessly. But this is not the end. It is interesting to ask what is ideal ramming. It would be probably difficult to come to a unanimous agreement upon this point, for the foundry still remains in a state so empirical that every individual is possessed of an opinion on this subject, more or less reasoned. It is perhaps possible to accept a statement that it would be rational that the hardness of the mould is proportional to the pressure of the metal, that is, rammed softer from the bottom to the top of the mould, so that under such conditions the gas will escape through the sand in a regular manner under the variable pressure of the column of metal. Other people would undoubtedly prefer the part of the core surrounded by metal to be softer. Such opinions are sensible.

Taking as an example a split axle box, the portions of the mould which are rammed the hardest should be shown darker in the case of a mould rammed by a jarring machine. For the drag it is exactly the opposite of what is required, and if for the cope it is good for the joint, it is bad for the higher portion of the casting. Unfortunately, no means exist to do otherwise. On the other hand, pressure-ramming permits the operator to vary at will the pressure on the mould. It is a recognised fact that the shocks of jarring machines give much trouble in the foundry*, and the number of highly ingenious contrivances which are supposed to overcome them merely show the number of troubles they cause. As a direct corrollary, the bending of the flasks when working on flat moulds renders work extremely difficult, since the rebounding of the sand, which, like the shocks, has given rise to the adoption of numerous and highly ingenious arrangements, renders the moulding very difficult, especially for flat moulds. Finally, jolt ramming produces in sharp angles and under bosses soft spots, which were recently the subject of a highly interesting discussion at the Congress of Foundry Technical Associations at Liége.†

If, in spite of all these inconveniences, jarring machines have assumed so great a development in America, it is because they have not only inconveniences, but they show also some advantages. These advantages are especially evident in very deep moulds, the bending of the flasks being completely suppressed. Under these conditions the rebounding is less dangerous. The differences of hardness from the lower to the upper portions of the mould are not so marked, and the packing of a huge mass of sand under these conditions is satisfactorily accomplished. Ramming not necessitating the use of special ramming plates, and consequently no preparation whatsoever for the machine, is thus possible to use for a limited number of moulds principally for ramming purposes, the pattern drawing being accomplished either on the machine or otherwise. However, it is a simple process, easy to understand by men used to hand moulding who only see in the use of the machines a method of reducing their fatigue, all the remainder of the work being carried out similarly to hand moulding. Briefly expressed, if compressed air pressure allowed of the easy ramming of large moulds, it is highly probable that the jarring machine would not have assumed such a great development, and we do not hesitate to say that in a country like England where compressed air is not very extensively used in foundries, and where hydraulic is used as an everyday matter, it was a false step to have exploited the jarring machine rather than to have preserved it for special cases where it shows outstanding advantages. Jarring machines also allow of the ramming of deep and narrow spaces in patterns such as those for long-ribbed heating pipes, which, however, American moulding machine makers declare impossible of attainment up to now. The use of squeezer machines has not always been understood. It is extremely easy to ram deep boxes with squeezer machines by carry-

** Lewis, page 28.

* (1) E. S. Carman, "Foundry Moulding Machines and Pattern Equipment," Penton Library, pages 13 et. seq.

† (2) E. S. Carman, "Foundry Moulding Machines and Pattern Equipment," Penton Library, page 32.

‡ (3) E. S. Carman, "Foundry Moulding Machines and Pattern Equipment," Penton Library, page 33.

‡‡ W. Lewis, page 28: "It is not, however, every pattern that can be rammed in this way, and care must always be taken to avoid projections on the pattern which interfere with the proper flow of sand. This sometimes necessitates the use of a core not required for hand ramming . . . Although the jarring machine is not universal in its application, it covers a very broad field of the work. . . . The packing of sand by jarring is naturally greater in a vertical direction than horizontally." Page 29: "To obtain the best results a good deal of judgment and patience is frequently required. . . ." The back and sides of the mould are not, of course, rammed as hard as the bottom.

§ E. S. Carman, page 15.

* W. Lewis, page 24: "It is not generally safe to set up finished moulds with hanging sand in the neighbourhood of a jarring machine of this type, and in some foundries the jarring machine has been just out of service for days or weeks pending the completion of large floor work. In fact, the damaging effect of large jarring machines is too well known to need confirmation, and to reduce this to a minimum the drop of the table has been decreased, while the foundation has been increased."

† See also W. Lewis, page 20.

ing out the operation in several stages. Usually two squeezings are sufficient, and as this work of pressing is quite rapid and that, once made, the work is not partly but entirely finished, it will readily be seen that there are found in many cases distinct advantages from the use of the squeezer machine, even for the deepest moulds, notably where pattern presents projections, bosses, loose pieces and the like. European practice, particularly French, differs considerably in this respect from American practice. Whilst in America the aim has been to simplify machine moulding by the use of as many cores as are exteriorly and interiorly necessary, in France the trend of affairs has been to keep the number of cores especially of a complicated nature to the strictest minimum. By this method of working, the cost price is reduced, because cores are expensive both in material and labour; and what is still more serious, they give rise to complicated core setting and ugly fins which have to be fettled by hand at a price which is sometimes three or four times greater than the total value of the mould. Much cleaner work and a much lower cost price is obtained, even though the production by the machine be less than if it had had to only make an envelope of a rough type of ore which in reality constituted the mould to set cores inside.

This work necessitates the greatest competence and skill in the manufacture of pattern plates which have to be left to the sole care of the moulders by the processes invented and developed by the Ph. Bonvillian & E. Ronceray Company.

The objections usually associated with squeezer machines are usually due to ignorance as to the best means of carrying out the operations. Without wishing to cast a slur upon foundrymen who go in for machine moulding, it is not an exaggeration to say that any competence which they might possess in hand moulding can scarcely help them if they are desirous of getting the best results from machine moulding. Carefully studied, this fact appears more natural than paradoxical. Little by little machine-moulding methods have been involved, and are distinctly moved from hand-moulding customs, so much so that the digression has become enormous, and perplexes the most open-minded persons.

Light on Hand Moulding.

On the other hand, however, progress which has been made with regard to machine moulding undoubtedly has thrown much light upon hand moulding. The following example will illustrate this point: Because of the incompetence of men operating machines, it is the custom not to admit that they patch the moulds.

The pattern plate must be perfect and the pattern drawing accurate enough to give a perfect mould requiring no patching. Such a perfection in working conditions allows of the use of a much dryer sand, the dampness essential for patching by hand being no longer necessary. Little by little the possibility of using dry sand has been recognised, and has allowed of the production of a dry sand which flows better under pressure, that is to say, which approaches, in this respect, silica sand, which, as everybody knows, runs like water when it is perfectly dry. The ramming is thus accomplished under much better conditions than with a damp sand, but this is not everything. The dry sand ramming better, consequently at a distance from the pattern, no longer necessitates the use of a presser head close to the moderately restricted or deep parts, but a simple finger touch before the press ramming. It does not scab, and it remains so permeable that it is practically useless to vent the moulds. These new and highly interesting conditions are brought about by the every-day machine-moulding conditions, and have been too precious not to be profited by when hand moulding.

In the author's demonstration foundry, which has been placed at the disposal of foundrymen, they are invited to take particular notice of the apprentices using practically the same sands for green-sand moulding as those used for machine moulding, and using little or no peg ramming, but merely the hand tucking and the butt rammer, using no venting, obviously excepting the cores. If sand breaks, it is damped only where broken, and even then to the least extent.

This example is only one of the aspects of the question. Many others present the same divergence between old-time methods, and those resulting from a systematic study of mechanical moulding.

Thus the question resolves itself into the following:—

(A) For all moulds, small or medium, in boxes or boxless relatively shallow, squeezing is to be selected.

(B) For all moulds, small or large, low or deep, where the pattern drawing is most important, and those where projections and numerous loose pieces are use, the pressure ramming is to be selected even when it involves ramming by two or more squeezings.

(C) For large flat moulds jar-ramming presents great difficulties. Jarring machines are, however, to be recommended where there is a special difficulty of ramming for which it is specially convenient (large number of narrow pockets of sand) in spite of the difficulties mentioned above.

(D) For large moulds, of deep and simple castings, in which the pattern drawing does not necessitate any great degree of precision, or when there are few moulds to make, the jar-ramming is to be recommended. The finishing is then mostly made by hand.

(E) Water pressure is desirable in all cases for pressure machines, it alone permits of pressure-ramming large moulds.

This means that where hydraulic pressure is used, the pressure machine exhibits distinct superiority. The combination of the two methods of ramming can give good results, and it is at all times desirable that the pressure remains the chief feature, which is rarely the case in existing machines.

Semi-Steel.*

Semi-steel (*fonte acierée*) was used to a considerable extent by the Allies for projectiles, and the author suggests that there is a considerable commercial field for its employment. He describes its physical properties, and states that its resistance to repeated impact is about six times that of cast iron, while the ultimate tensile stress is about double. The chemical characteristics are given as:—S less than 0.12 per cent.: P less than 0.2 per cent; total carbon content less than 3.2 per cent. (of which approximately three-quarters is in the graphitic state); Mn 0.7-0.9 per cent.: and Si 1-1.8 per cent. The various methods of associating the iron and the steel, and the regulation of the proportion of graphitic carbon by adjusting the silicon content, are described. Numerous experimental results are tabulated and plotted, and the author comments upon these and explains the influence of the chemical composition upon the physical properties. Precautions to be taken during production are touched upon, and it is suggested that a shear test and a Brinell hardness test would afford sufficient evidence on which to accept or reject the material.—Prache ("Rev. Mét.").

Foreign Trade in September.

According to the Board of Trade Returns, the following figures show in tons the imports and exports of pig-iron, etc., for the United Kingdom during the month of September: tonnages for the nine months ended therein being shown in brackets:—

Imports: Pig-iron: Forge and foundry, 5,904 (37,650); acid, —— (155); basic, 5,761 (68,614). Castings, 318 (4,770); cast-iron pipes, 1,902 (14,184).

Exports: Pig-iron: Forge and foundry, 47,471 (180,363); acid, 22,279 (163,239); basic, 200 (3,242). Castings, 173 (1,048); cast-iron pipes, 5,815 (48,097).

At a meeting of the Birmingham section of the Institute of Metals, on October 10, Dr. F. Johnson gave a lecture on "Iron in Copper and Copper Alloys."

* Inst. C. E. Foreign Abstracts.

Heating Metal Patterns Electrically.*

By C. A. Cremer, Westinghouse Electric and Manufacturing Company, Pittsburgh.

When moist moulding sand is rammed up around a cold metal pattern a thin film of moisture collects on the surface of the pattern so that when it is withdrawn from the mould there is a tendency for some of the sand to adhere to it. This causes a roughening of the surface of the mould so that it will not yield a clean smooth casting. For many classes of work it is essential that the castings be clean and smooth, and therefore means must be used to overcome this tendency of the sand to stick to the pattern.

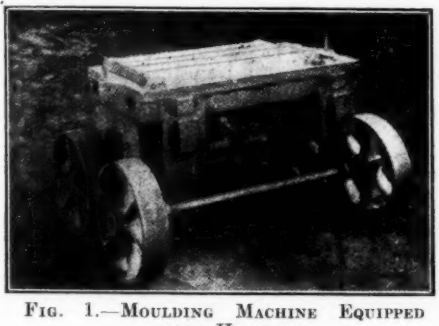


Fig. 1.—Moulding Machine Equipped with Heater.

There are two ways of preventing this trouble; one is to dust a parting compound over the pattern and the other is to heat the pattern.

Compounds.

If a parting compound is used it must be applied frequently, at least for every second or third mould. This takes a certain amount of time, and furthermore it may be done carelessly, with the result that parts of the mould may not be covered, in which case imperfect moulds would result. This imperfect covering of the mould would be especially likely to happen in the case of intricate patterns or patterns with surfaces nearly perpendicular to the plane of the mould, to which surfaces the compound might not readily adhere.

Proper heating of the pattern, however, insures that all parts are equally prepared to prevent the sticking of particles of sand, and eliminates the time required for applying the compound.

The most common methods of heating metal patterns are by means of a gas flame or a paraffin torch. The gas flame is more readily applicable to stationary moulding machines, but cannot be conveniently used for portable moulding machines which are moved along the foundry floor as the making of moulds progresses. In such cases the paraffin torch, or a tin can filled with sand on which kerosene has been poured, is more frequently used.

The disadvantages of such crude heating methods must surely be apparent to anyone who has had experience with them. In the case of moulding machines heated with a gas flame the usual method is to maintain a gas flame within the framework of the machine in the space under the pattern plate. It is difficult to keep the flame low enough so that the pattern will not be overheated. Furthermore, the heat from a gas flame is localised, whereas what is wanted is a uniformly distributed heat so that all parts of the pattern will be equally heated. To overcome these difficulties with low flame and localised heat, it is customary to burn a larger flame than is actually required to produce the necessary heat for the pattern and to locate that flame at a greater distance from the pattern plate. This, of course, is an inefficient arrangement since a large part of the heat is wasted. It has an added disadvantage in that the gas fumes are unpleasant for the workmen, and in the summertime the heat is objectionable. Also with this method of heating variable gas pressure makes frequent attention necessary, and in some sections of the country where there is a scarcity of gas in cold weather there may be no gas pressure at all at times when the use of heat is most necessary.

* A paper read before the American Foundrymen's Association.

Using Paraffin to Heat Pattern.

The objections to the use of kerosene torches or tin cans filled with sand saturated with paraffin—which are said by some who have used them to be better than torches—must be even more obvious than the objections to gas flames. Aside from all difficulties with the moulds being too hot or too cold, necessity for cleaning and refilling the torches, and general inconvenience, messiness, and crudity of the method, the fact that there is a constant emission of evil-smelling fumes right into the faces of the men working over the moulds has been sufficient reason, in at least one case, for the manager of the plant to apply a more modern method of heating the patterns.

At the West Newton plant of the U.S. Radiator Corporation a considerable number of metal patterns are used from which moulds are made continually throughout the day. It had been the practice at this plant to warm the patterns by means of kerosene torches to prevent the sand from sticking to them, since it was essential that the moulds be perfect. But warming the patterns with kerosene torches was a dirty, smoky operation and not at all popular with the workmen.

Experiments with Electric Heat.

The manager of the plant conceived the idea of applying electric heaters to the patterns, and made preliminary experiments with heating elements from electric sad irons. The shape of these elements prevented their most efficient application to the pattern, and they did not stand up well, but the result indicated that electric heating of metal patterns was practicable.

While in search of more suitable heating elements the manager heard of the steel-clad type of heater. Two of these heaters were secured and applied to the patterns. The results were so satisfactory that now about 15 patterns are equipped with similar electric heaters.

Fig. 1 shows the general shape of the pattern with its supporting carriage. The power is supplied from an ordinary lamp socket through a flexible cord, which is attached to the pattern carriage. In moderately cold weather the heat is used intermittently as the need for it appears, but in extremely cold weather the heat is left on continuously while the pattern is in use. The capacity of the heaters is 600 watts at 110 volts, and the temperature to which the patterns are heated is approximately 32 to 37 deg. Cent.

Applying Heater to the Pattern.

Standard steel-clad heaters of the narrow type, which are in the form of a long, flat strip approximately 20 in. long, $1\frac{1}{8}$ in. wide, and $\frac{1}{8}$ in. thick,

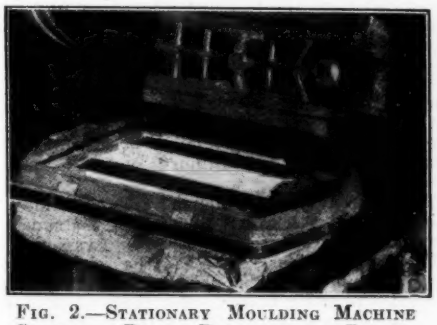


Fig. 2.—Stationary Moulding Machine Showing Plate Removed to Reveal Position of Steel-clad Heater.

are laid in grooves cut in the face of a cast-iron plate which forms the top of the carriage. The heater terminals project downward through holes drilled through this plate, and are wired to a socket on the side of the carriage. The upper surface of the heaters, which are perfectly flat, are flush with the upper surface of the plate, so that when the pattern plate is laid on the top of the carriage the heaters are in contact with it. With the pattern plate in place, and fastened with suitable bolts or screws, the assembly is similar to the

construction of a modern electric iron—the heating elements being firmly clamped between two metal plates, so that the heat from the heating elements will be transmitted by conduction to the working surface. This enables the heaters to operate at a relatively low temperature, and makes the surface of the pattern quickly responsive to the application of heat.

Some of these pattern carriages have been equipped with electric heaters mounted in the space below the pattern plate, but not in contact with it, so that the heat is transmitted to the plate by radiation instead of conduction. This method is not so efficient in utilisation of the heat, and results in slightly greater power consumption and lower heating, but is otherwise satisfactory. It is a cheaper method of installing the heaters, and in some cases it may be the most practical method.

The manager of the plant where these electrically-heated patterns are in daily use has reported that the use of electric heat has been cheaper than the use of the kerosene torches, besides being more satisfactory in other ways, particularly with respect to the absence of obnoxious smoke and fumes.

At about the same time that electric heaters were being applied to the radiator patterns, another manufacturer installed electric heaters of the same type in a moulding machine. As in the case of the radiator patterns, the method of applying the heaters consisted essentially in arranging and supporting them so that they would be in contact with the under side of the pattern plate below the thickest part of the pattern. The heaters were not attached to the pattern plate, but were supported on angles attached to the frame of the machine, and therefore their presence did not interfere with the changing of the pattern whenever required.

The heaters are of the steel-clad type, which consist of slotted ribbon heating elements of high resistance, heat-resisting alloy, insulated with a mica envelope, and the whole enclosed with a sheet-steel casing applied under hydraulic pressure of two tons per sq. in. At each end of the heater the steel casing is extended to form a mounting lug, and has two holes punched in it for the fastening screws. The terminals are at one end of the heater, and are protected with a substantial metal cover.

Fig. 2 shows the pattern plate removed to display the heaters mounted on the angles in the frame of the machine. In order to conserve the heat an asbestos heat-insulating plate was placed just below the heaters to prevent loss of heat by radiation downward from the heaters.

Heaters do not Hinder Operation.

The presence of the heaters did not in any way interfere with the usual operation of the machine or the functioning of the mechanical vibrator, and the entire installation was made without any modification of the machine other than the drilling and tapping of small holes for attaching the mounting angles.

The machine takes a pattern plate 16 × 11 × 2 in. The two heaters applied were each 7 in. long, 2¼ in. wide × ¼ in. thick, and had a total rating of 300 watts at 110 volts. Connection to the source of power was made by means of a flexible cord and an ordinary separable attachment plug.

The simplicity, convenience, and cleanliness of this method of heating metal patterns must be obvious. The cost of operation varies with different conditions, such as the size of the patterns, number of moulds made per hour, and the price paid for power. But the cost of operation is a relatively small item in any case, and quite inconsiderable in comparison with the advantages of the method. As a matter of actual experience, in cases of which we have record, the electric method of heating patterns is really cheaper than the methods previously used.

The Controla Engineering Company, Limited, have removed from 47A, International Exchange, Birmingham, to Lower High Street, Stourbridge. The company are the makers of the "Controla" automatic gas controller, for reducing and regulating consumption in connection with furnaces, engines, etc.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

"Making Castings without Feeding Heads."

To the Editor of The Foundry Trade Journal.

Sir,—In your issue of August 17, No. 313, you published an article on the above subject, by Mr. S. G. Smith, which is distinctly controversial. Whilst I am at all times willing to discuss scientific subjects, or facts, with any foundrymen who may be interested in my lecture on this subject, or in my experiments in the same direction, I do not think it will serve any good purpose to enter into a controversy in your Journal on these matters.

I am convinced from my previous experiences that journalistic controversies, no matter how clearly cases may be stated, are apt to lead to misunderstanding and consequent confusion, to the detriment not only to the persons taking part in such discussions, but also to all members of the foundry trade, who might be misled by such articles.

As, however, I should like to make my meaning absolutely clear to the gentlemen in Great Britain who are interested on this subject, I intend to accept the very cordial invitation I received from both Sheffield and Newcastle Branches of the Institution of British Foundrymen, and to speak once more on this subject at either of these places, probably in the early spring of next year. No doubt the definite date of the meeting will be published later, and I hope Mr. Smith or any gentlemen who are interested in this subject will see their way clear to attend, when I shall be pleased to explain as clearly as I possibly can my meaning, and also, if possible, place fresh data before the meeting.

I hope Mr. Smith will agree with me that this is the best course to pursue, in order to minimise the possibility of misunderstanding.—I am, Sir,

Yours, etc.,

Thiais, E. Ronceray.

October 10.

If the writer under the *nom de plume* of "Ajax" will be kind enough to inform us of his identity we shall be pleased to publish his interesting communication.

Iron and Steel Production.

The production of pig-iron in September amounted to 430,300 tons, or 18,600 tons more than in August, and the highest figure attained since February, 1921, when production amounted to 463,600 tons. The output is, however, still only 64 per cent. of the average monthly production in 1920 and 50 per cent. of the average monthly production in 1913. The September output included 123,700 tons of hematite, 137,800 tons of basic, 113,400 of foundry, and 25,900 tons of forge pig-iron.

The production of steel ingots and castings amounted to 555,900 tons in September, a figure higher than in any previous month since December, 1920, when it was 746,600 tons. It represents 73 per cent. of the average monthly production in 1920, 87 per cent. of the average monthly production in 1913, and about 50 per cent. of the steel-making capacity of the country.

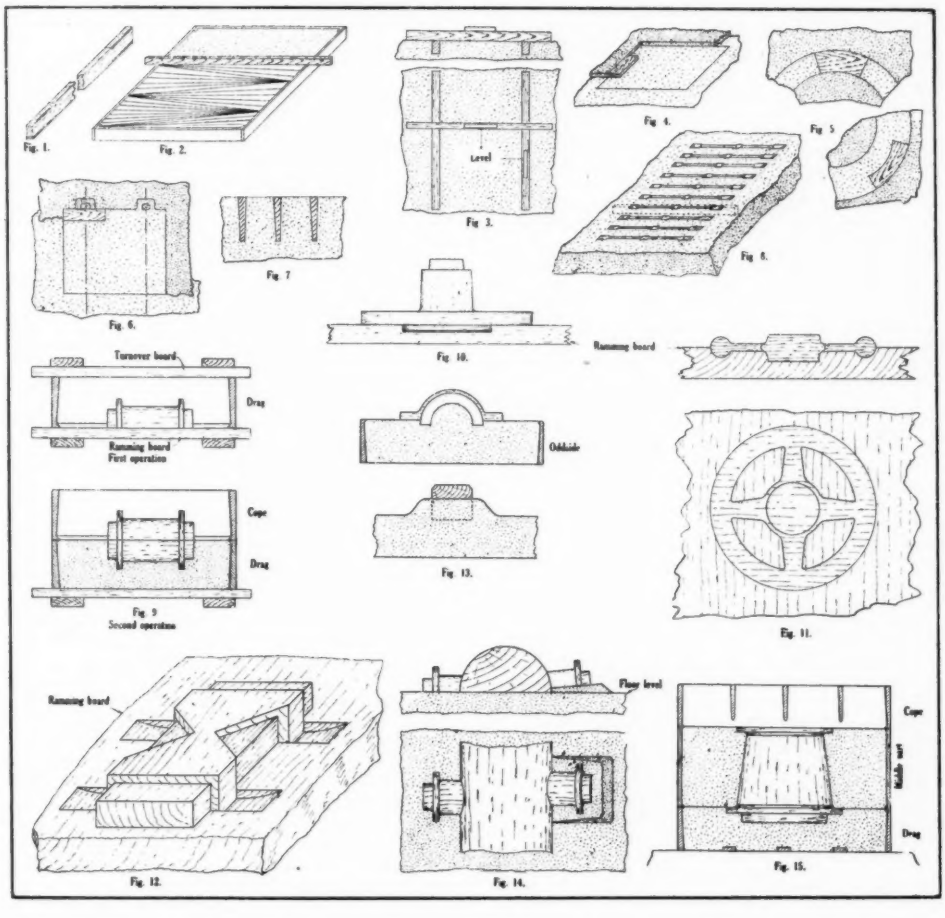
Mr. T. E. Hull presided at the first annual meeting of the West Yorkshire Metallurgical Society, held on Saturday last at Huddersfield. The report stated that, although the Society had not been established a full year, the number of members had reached 45. It had been suggested to the Committee that, by co-operation between members of the Society, a suitably organised scheme of original research could be carried out. The rules provided for no such activity, and in reply to a questionnaire on the matter little expressed opinion was obtained, so that the scheme had been left in abeyance. The chairman said that, notwithstanding the smallness of the membership, there had been efficiency and enthusiasm in a district which could not be regarded as a metallurgical one.

An Apprenticeship Course in Foundry Practice.—XIV.

By Ben Shaw and James Edgar.

GREEN SAND MOULDING.

Moulding in green sand is classified under two main headings, which are known as open-sand moulds and closed moulds. Unless castings are described specifically as open-sand castings, it is taken for granted that they have been made in closed moulds. While green-sand moulds may be either covered or otherwise, the uncovered mould is particularly applicable to green-sand moulding, and it is rarely indeed that a casting is made in an uncovered mould consisting of dry sand or loam. It must not be inferred, however, that green sand is preferred for uncovered moulds because it is impracticable to make them in dry sand or loam, but simply that an open sand casting is the cheapest form of casting, and green sand offers the most economical means for making the moulds. Castings required to be made in open sand are usually of a plain design, and they can be safely cast in green-sand moulds.



Open Sand Moulding.

This method is restricted in its application. If high-grade castings are required, moulds must be covered, and the fact that there is no covering of sand to form the top shape confines its usefulness to work which is flat on one surface, because fluid metal is similar to other liquids, in that it rises in a mould horizontally and the surface of the metal remains flat when the mould is full. When metals are fluid and are cast into moulds, a continual state of ebullition exists during the time the metal remains in a fluid condition, owing to the rapidity with which it gives off heat, and the metal solidifies while it is in this state of commotion, consequently the surface of the metal, when solid, is rough. Usually the commonest of castings only are made in open sand because of these limitations, and they consist mainly of moulders' tackle, such as is used in the construction of moulds or cores, and which includes foundations and lifting plates, building rings, grids, etc. Commercial castings are sometimes made in open sand moulds, when the roughened surface is compensated by their relative cheapness. Such castings as floor or stokehole plates, some forms of footsteps, single or double firebars, and gratings of various kinds, are examples of work frequently cast in open sand moulds. This form of moulding can be used for any casting which has projections on one side only, and when the rough side can be bedded into the ground, into cement, or built into masonry. Invariably foundry tackle is cast in a special open-sand bed, whereas other castings are made as required in the green-sand floor. The size of the open-sand bed varies with the size of the foundry and the character of castings made.

Preparation of Open-Sand Bed.

In a general foundry, covering a wide variety of work, the open-sand bed is prepared every day that a cast of any kind is made, and, under ordinary working conditions, this may mean every working day. The bed is generally raised about 9 in. or 10 in. above the foundry floor-level, and is surrounded by a cast-iron frame bolted together. The top edges of the frame are straight and are set so that they are level. Usually two men are in charge of a large bed, and they are responsible for turning over and tempering the sand each casting day and adding new sand as circumstances demand, preparatory to levelling off, flush with the sides of the frame. The sand is not rammed in the usual way, because, for this kind of open-sand casting, the sand need only be lightly consolidated and tamping with the straight edge which bears

upon the frame is sufficient. The bed should contain sufficient sand in order that when it is turned over it projects above the top edge of the frame and it is this projecting sand which is tamped down and any surplus strickled off. The straightedge is generally of wood, but substantially made, and having hoop iron secured to the parts of the edges which bear upon the frame side, as shown in Fig. 1. The process of levelling the bed involves the labour of two men, who alternately operate with the straightedge, while one holds down one end of the straightedge the other tamps the sand, and strickles off any surplus with his end of the straightedge forming a sector of levelled sand with the bearance of the straightedge at one end as the centre. This method is reversed repeatedly, as shown in Fig. 2, until the whole of the bed has been levelled.

When a special bed is made on the foundry floor the sand is rammed, though not necessarily to the same extent as would be required for a closed mould, and straightedged logs are set in the floor and tested for being level and in the same plane. No tamping is done with the straightedge in this case, as the logs can only be used as a guide. Sand is rammed between them and strickled off flush with the top edges of the logs and again tested to make sure that no movement has taken place in the process. The logs are finally withdrawn and their impressions made up to the surface of the bed if necessary. The method is indicated in Fig. 3.

Making Open Sand Moulds.

In preparing the moulds for tackle the bed is allocated to the different moulders needing it as soon as the bed has been levelled off. Plates and grids are marked off by means of rough templates or with the aid of laths or trammels. The impressions for grids are stamped into the sand by means of the stamps, but the moulds for plates are usually made up to the required thickness on top of the bed, the surface of the bed forming the bottom of the mould. The patternwork used for such plates is of the most simple character and comes under the category of sectional patterns, supplying a part only of the desired shape, but sufficient to enable the moulder to make the complete mould. For ordinary plates, with lifting staples cast in, a rectangular piece of wood, having a thickness slightly in excess of the required thickness of the plate, is all that is needed. The shape of the plate marked out on the bed, is used as a guide, and the sectional pattern used to make up the sand in the manner shown in Fig. 4. The same method is adopted when a circular building plate is required, but the sectional pattern is cut to represent a segment of the plate or, when the plate is wide, and it is desired to make up the sand inside and outside separately, the sectional pattern need not be made the full width as long as the concave and convex sides correspond with the respective markings on the bed. Both methods are indicated in Fig. 5. When snugs are required to be cast on plates, the centres about which they are to be cast are marked on the bed, and a part pattern, corresponding in shape to the snug, is located about the centres as the formation of the mould proceeds, in the manner indicated in Fig. 6. The sand forming the thickness of the plates is always rammed and it is important to make the mould deeper than the desired thickness of the plate because there is the possibility of considerable fin if it is completely filled, which besides being a danger to other moulds, is a nuisance on a casting.

Although the preparation of a bed is preferable when the foundry floor is used and when the castings are to be made flat, patterns are frequently bedded into the floor and the upper surface tested with a spirit level. Making moulds for firebars to be cast in open sand is an example of such a method. Generally two or three patterns are used because a quantity of castings is invariably required. The sand of the floor is softened and the patterns are knocked in parallel to each other and about 6 in. apart until the top edges are flush with the floor. The patterns are then adjusted until they are level, when sand is rammed about them and is levelled off to form the surface of the moulds, as shown in Fig. 7. The advantage of having two or three patterns is in evidence during the time of stripping and in proceeding with the formation of the moulds. When two patterns are supplied, only one is stripped at a time, the remaining pattern being left in the sand until the first pattern is again rammed up. When three patterns are used then two can be stripped and rammed up again, and this process is repeated until the requisite number of moulds are prepared, or until it is necessary to commence another row of moulds, when the final pattern is withdrawn and the whole process recommenced. The single pattern is left in its mould as a protection against damage while the sand is being rammed about the next pattern. The moulder further protects the moulds by resting a straightedge or any piece of wood across the mould surface and separating the completed moulds from those from which the patterns have not been withdrawn as illustrated by dotted lines in Fig. 8.

It is rarely indeed that special facing sand is used for open sand castings, a good surface being sacrificed for cheapness, and, with very few exceptions, this class of moulding is confined to the cheapest of metals, namely cast iron.

Closed Moulds.

By far the greater number of castings are made in closed moulds, that is moulds which are covered, because their usefulness is not limited as with open sand moulds. All types of castings, whether intricate or not, are more satisfactory if made in a closed mould; indeed, with the majority of castings, it is the only possible way. A closed mould need not necessarily be set with its upper surface in a horizontal direction to be cast, as the body of sand that comprises the cover becomes part of the mould and it arrests the flow of metal when the mould is filled. When the fluid metal has completely filled the mould the air is excluded and the metal lies quietly against all the surfaces of the mould, providing the venting has been attended to, there is, therefore, no roughened surface on the casting. Not only does the upper surface of a casting, made in a closed mould, compare favourably with other surfaces with regard to the smoothness of skin produced, but it can be shaped and impressions of projecting parts carried in the cover. This is possible because the metal cast in a closed mould is under pressure, which forces it into the top impression and, incidentally, this pressure is responsible for making the texture of the metal more dense, thus providing a stronger casting than is possible from an open-sand mould, other conditions being equal.

Patterns used in the preparation of covered moulds are entirely enclosed in sand, and it is necessary to construct the moulds in parts so that they can be separated, in order to withdraw the patterns. The number of parts varies with the design of the castings to be made, and the moulds are referred to as a two-part, three-part, or four-part mould according to the number of parts necessary.

Two-Part Moulds.

A mould consisting of a bottom or drag and a cover or cope is known as a two-part mould. This form of mould is used when the design of the casting and the construction of the pattern are such that the pattern can be extracted, when the two parts of the mould are separated without destroying the formation of the sand about it. The shape and area of the mould at the junction of the two parts must also admit any loose bodies of sand that may be necessary to form the internal shape of a casting and without which it would be impossible to withdraw the pattern. A two-part mould is all that is necessary for the majority of castings, because, frequently, parts of a pattern which would prevent its withdrawal are made loose in order that the main pattern section can be withdrawn and the smaller, loose parts removed separately. When this is not possible parts of the mould may be made loose and lifted from the joint as mentioned above, or elsewhere in the mould in order to free the pattern or to allow for the introduction of cores, but the mould as a whole remains a two-part mould. We shall deal more fully with such instances in subsequent articles, but it is necessary to point out at this juncture that, with the general run of work, the number of parts used is limited as much

as possible for economical reasons of which box equipment is one of the most important.

Preparation of Two-Part Moulds.

We have previously stated that the major part of a mould is formed in the drag; the exceptions concern those castings which are of such a shape that the junction of the two parts of each mould coincides with the centre of the casting, such as for example cylindrical castings, which are prepared horizontally. Generally, however, the cope is merely used to provide a cover, and the impression it carries is comparatively small, the main part of the mould being prepared in the drag. This method is advantageous, because it is the cope which is located on the drag when assembling the mould for casting, and the reduction in the body of sand due to the necessity of having considerable top shape would render it more liable to collapse when inverted, or, it would necessitate a substantially deeper box part and increased liftering to carry the sand successfully. When cores are required to be inserted in the mould it is better that as little as possible should project beyond the drag so that the pins of the box part will register before the projecting cover core is engaged in the cope, and this can only be accomplished satisfactorily when the greater part of the mould is made in the drag. In the actual preparation of moulds in green-sand either the turnover or bedding-in methods may be adopted, and these methods are equally applicable in the preparation of dry-sand moulds. In green-sand work, however, the turnover method predominates, whereas bedding-in is more frequently adopted in dry-sand work. We shall therefore content ourselves in this article with the preparation of green-sand moulds by means of the turnover method and consider the bedding-in method later.

Turnover Method.

When the turnover method is adopted it means that the drag is rammed up in an inverted position and then turned or rolled over preparatory to making the cope. The method possesses many advantages over bedding the pattern in the sand, because the sand can be more regularly consolidated, and it is more accessible for ramming; less work is required in the formation of a joint for the cope, as, not infrequently, no tool work is involved when the drag has been turned over, and incidentally, the pattern is subjected to less rough usage, and economical consideration often omitted. The turnover method is partjcularly suitable for work, the pattern for which will rest flat upon a board or sand bearance, or, when the pattern is so jointed that part of the pattern can be laid on a board with its joint next to the board. The drag part should also be placed on the board and about the pattern when sand can be shovelled in and the whole part rammed up and sleeked off flush with the bottom. It is at this stage that the drag is turned over and a turnover board may be necsary to support the sand in the drag while it is being inverted. This, however, usually only applies to the smaller box parts that have no bars cast in them. The method is indicated in the two sections, Fig. 9. The board, known as a ramming board, upon which the pattern is laid, is flat in this instance because the pattern, being in halves, one half rests flat. When the drag has been turned over the other half pattern can be located and the cope part set, the drag then becoming the ramming board for the cope. When the joint of the mould is not straight or when the pattern is solid and of such a shape that part of the impression must be carried in the cope then the ramming board should also be varied in order to form the shape of the joint desired, when the drag is rammed on it. If a large number of castings are rquired, and the moulds must be made by hand, a wooden ramming board may be prepared either cut, so that the pattern rests flat upon it, as in Fig. 10, or, to allow the pattern to be introduced into the position until the level portion of the board coincides with the position of the pattern at which the joint should be made, as in Fig. 11, or, it may be recessed to form the joint as in Fig. 12. Apart from machine-moulding very few shaped ramming-boards are now used on the floor or at the bench, because of the expense in their preparation, when only a few castings may be needed. It is more economical to use machines when quantities of similar castings are required, and the ramming-board becomes a pattern or match plate, which we shall consider in connection with machine moulding. When it is not possible to use a flat ramming-board on the floor or at the bench an odd-side or false part is usually prepared to act as a ramming-board, either a box or the floor being used for the purpose.

Odd-Sides or False Parts.

An odd-side is a temporary expediency for supporting the pattern and determining the shape of the joint of the drag prepared on it. It is prepared in a box part corresponding to the part to be used for the cope, or the part of the pattern which is to form the impression in the cope may be bedded in the foundry floor and the joint shaped as required preparatory to locating the drag about the pattern. Usually ordinary moulding sand is used to make odd-sides, and if they have been carefully prepared they can be used a number of times. Plaster of Paris odd-sides may be prepared when many castings are to be made or a special wax-composite may be used. Sand odd-sides are, however, in more general use. A simple illustration of an odd-side for a bearing cap prepared in a box part is shown in Fig. 13, and in Fig. 14 the odd-side shown is for a branched pipe using the foundry floor. In both these instances it is preferable to make the surfaces level in the first place and then lay the pattern or pattern section in position and make up the shapes as indicated. It is frequently desirable that a level surface should be prepared at the outset even when the surface must be cut to admit the pattern, then only that part of the joint which does not coincide with the joint of the box part need be made up. When the odd-side has ceased to be of value as a means of forming the joint, the sand is knocked out, thus it is merely a temporary form of ramming-board.

Three-Part Moulds.

Moulds are prepared in three parts when the designs of the castings to be made prevent them being made in two-part moulds; or, when the work involved would be more easily done by making each mould in three parts. It is for similar reasons that moulds are sometimes made in more than three parts. It is sometimes necessary to use a three-part box for a two-part mould in order to have the depth of two-box parts for the drag, but only one joint is necessary, therefore the mould remains a two-part mould.

Preparations of Three-Part Mould.

A three-part mould is prepared in a similar manner as a two-part mould by means of the turnover or bedding-in methods. Although the drag is sometimes rammed separately in an inverted position when the pattern is jointed, so that this method is possible, frequently the middle part is rammed first in an inverted position, the drag prepared on it, and the two parts are clamped together for turning over to proceed with the cover. The method is illustrated in Fig. 15. When three parts are employed it is the middle and drag parts that form the main impressions. Frequently that part of the mould formed in the drag is very small compared with that in the middle part, and the foundry floor is sometimes used instead of a box part, a method which involves the bedding-in process.

The American Tariff and Solingen.—A Berlin report states that the steel-ware industry of Solingen—the German Sheffield—has suffered considerably as a result of the putting in force of the new American tariff, a large number of orders from the United States having been cancelled. A great decline in the number of new orders from America is also noted. The falling-off in American orders is a severe blow to Solingen, as during recent months about 50 per cent. of the total production has gone to the United States. Apart from the loss of business with America, orders from other quarters are scarce, not only in the steel-ware industry but also in other Solingen works, and a number of firms are already considering the question of slowing down.

The John Surtees Memorial.

The Newcastle Governors of the above Memorial, in inviting applications from candidates for competition for the medals of the respective classes as provided by the fund, state that they hope that the funds will permit of the awarding of supplementary prizes, therefore they expect that a good response from aspirants to these honours will be forthcoming.

The examination for senior candidates will be based upon the following subjects: (1) A calculation; (2) practical moulding on a sample pattern to be selected by the Governors; (3) sundry other alternative questions to be followed by an oral examination on practical foundry subjects.

RULE XVII.—The Senior Examination shall be open only to Members and Associate Members who have served a regular apprenticeship as moulders and coremakers in a foundry and are engaged as moulders or officials in a foundry at the time of examination.

NOTE.—The Senior Examination shall be open only to Associates and Associate Members whose apprenticeship has ended not later than the date on which such member reached twenty-one years of age.

RULE XVIII.—The Junior Examination shall be open only to members who are apprentice moulders and intend to continue at the trade as journeymen, officials or principals.

For the junior candidates the following subjects have been chosen: (1) Model drawing of a simple pattern to be selected by the Governors; (2) practical mathematics; (3) simple questions in geometry; (4) practical workshop (foundry) questions. These may be set as a paper, or taken orally, or both, at the discretion of the Governors.

The rules and conditions governing the examinations are based upon the deed of the John Surtees Memorial, of which the following are the most important:—

Each candidate entering the examinations must agree to observe the rules and conditions laid down by the deed of gift, and accept the decision of the Governors as final.

Applications from candidates must reach the Secretary, Mr. H. A. J. Rang, of 2, St. Nicholas Buildings, Newcastle-on-Tyne, not later than October 31, 1922, after which date no applications will be considered. Notice of the date and place of examination will be sent to candidates in due course.

RULE XIV.—The Competition shall be open only to Members, Associate Members and Associates or the equivalent degree of membership as they may be designated from time to time by the rules of the Institution of British Foundrymen, subject to the following qualifications and conditions.

RULE XV.—Competitors must have been Members, Associate Members or Associates of the Institute of British Foundrymen, Newcastle or Scottish Branch as the case may be, for not less than twelve months at the time of the examination, save and except in the Junior Class, in which Class this condition may be suspended at the discretion of the Governors concerned.

RULE XVI.—There shall be two grades of competition, namely, Senior and Junior.

It will be remembered that the funds for this memorial have been provided by Mr. William Mayer, of Dumbarton, a past-president of the Institution of British Foundrymen. We illustrate above both the medal and the lid of the case which contains it.

It now remains for other generous-minded foundrymen to follow Mr. Mayer's lead so that other branches may utilise the memory of John Surtees for disseminating foundry knowledge.

A LONDON SYNDICATE has acquired a controlling interest in the Mill Close Lead Mine, near Matlock. The intention is to develop the mine by the provision of additional capital, etc.

Foundry Cupolas.

By E. A. Roper.

It is now generally admitted that foundry proprietors and managers are taking a more genuine interest in the cupola as an important factor in foundry efficiency, and the object of this article is to give point to that interest, by discussing various details in cupola design, and their effect on its working.

Recent research has proved that the chief difficulty in providing the correct iron for the moulds is that there are so many variable factors in the general problem, which are inter-dependent, and that this problem is greatly simplified with a cupola plant that can be relied upon to give practically regular working results day by day.

This calls for a well-designed plant by engineers who specialise in this unit, after a careful consideration of the work for which it is required, experience having shown that the old idea that anybody could rig up this themselves, and thus save money, is not a practical policy in the foundry of to-day, such a plant too often proving an "expensive luxury."

All cupolas, of course, embrace a steel shell of suitable diameter, with a refractory lining, suitable for the high internal temperature, and of such a width that will prevent the radiation of heat in the portion below the charging hole.

As the heat is greatest in the melting zone and also the need for preventing radiation, a well-defined lining should be widest at this point. The highest quality of material obtainable is no doubt the cheapest, as repairs and re-lining are costly, and the material from which it is made should be free from an excess of lime and alkalies, as they can be distinctly detrimental.

Many people with large cupolas on heavy duty use hollow cast-iron lining blocks, which start about 2 ft. above the melting zone, and are supported on the bricks below, and with a strong internal angle iron ring on the cupola shell. This being fitted where the charge is constantly moving, cuts down the cost of repairs, as it gives a more durable wearing surface. There is, however, a greater loss of heat through radiation with this practice, which means increased fusion coke to set against this economy.

Better practice would be obtained with a higher type of refractory which combines a better wearing surface with low conductivity. Cast-iron blocks can be used with advantage in the region of the charging hole up to 3 ft. below it to halfway up it, as the heat lost here through radiation is practically waste heat, and ordinary fire-bricks are usually badly damaged from the throwing in of the charge.

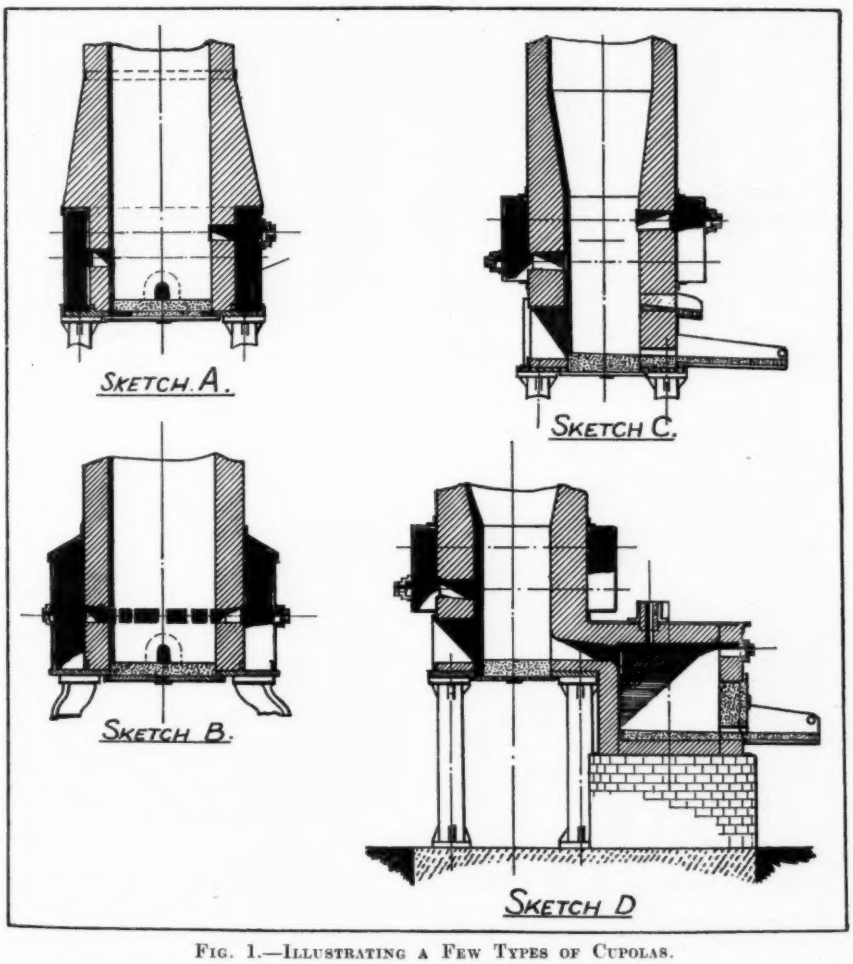


Fig. 1.—Illustrating a Few Types of Cupolas.

Reducing Cupola Chimneys.

Where it is necessary to add 10 ft. or more to the standard height, and particularly where a spark arrester has to be fitted, a substantial saving in first cost can be effected by reducing the diameter of the chimney above the charging hole, as this reduces the weight of the steel shell, lining, and the size of the spark arrester required.

There is no disadvantage in this practice if the reduction is not more than $\frac{1}{8}$ of the diameter for cupolas over 5 ft. diameter and $\frac{1}{4}$ for cupolas below this. If too great a reduction is made, however, the flames will flash out of the charging hole, owing to the increased velocity at which they

have to pass up the chimney and the pressure necessary to produce this. With the reduction as suggested no trouble is experienced at the charging hole, and the only result is that the sparks, etc., are carried to a greater height above the top of the cupola, and spread over a larger area when they fall. Where a spark arrester is fitted, the increased velocity helps this to operate, as the sparks are usually deflected from a plate, or by a right angle, or U-shaped bend in the chimney.

Drop Bottoms.

Drop bottoms are now a generally accepted feature for all grades, with the exception of malleable work, the hearth being made with ordinary floor-sand, rammed on to the drop-bottom doors, which are hinged on the underside of the bottom plate which carries the cupola, and held up with a draw-bar, or other means.

This provision greatly facilitates the removal of the unburnt coke bed and slag at the end of the blow, as the doors can be opened, allowing this to drop out at the bottom. This will drop quite clean if the slag is in a liquid state, and for this purpose the doors should be opened as soon as possible after the last metal has been tapped, and a small amount of blast left blowing through the cupola to maintain it hot until it has been done.

Blast Volume and Pressure.

The most essential features in the design are those relating to the introduction of the blast to the bed, and the volume and pressure of blast at which the cupola is required to work. This should be introduced in such a way that the coke bed is uniformly heated right across, so that as little chilling of the slag as possible occurs, and the fusion coke can be burnt uniformly in the melting zone.

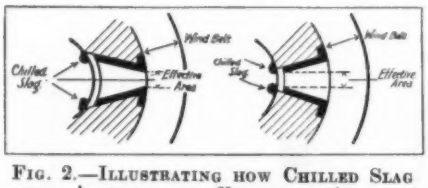


FIG. 2.—ILLUSTRATING HOW CHILLED SLAG SOON AFFECTS THE EFFECTIVE AREA OF CONVERGING TUYERES.

Various means are employed for this purpose, numerous tuyeres, equally spaced round the cupola in one or two rows are used to get a good distribution. The tuyere openings are splayed on the inside to spread the blast over a larger area of the coke, thus reducing the chilling effect on the slag, and also by reducing the internal diameter of the cupola at the tuyeres, as shown at C and D, Fig. 1, so as to introduce the blast nearer to the centre of the bed.

Blast Volume.—Since cupolas are in use on all grades of foundry work, this will only be a constant when working on one regular grade, and varies as the fusion coke required on the different classes of iron melted. As this varies from approximately 1¾ to 2¾ cwt. per ton, the volume of the blast should vary from 28,000 to 44,000 cub. ft. per hr.

The point of importance in connection with blast volume is that the correct amount to burn the fusion coke should be supplied, and any more, or less, is interfering with the proper working of the cupola, and one of the chief causes of indifferent results.

A cupola and blower may be installed suitable for general work, and used for a lower grade, providing the resistance in this is correct, but a blast-regulating valve must be fitted to the cupola, and a volume gauge available for use, until the attendant is familiar with the adjustments necessary to this valve.

To ensure that an equal volume of air shall be distributed by each tuyere to the bed coke, an annular steel wind-belt is built round the cupola, and this should be of ample capacity, in order to act as a receiver, and not merely as a convenient form of connecting pipe to the tuyeres. The area of a vertical section of this belt at any point should be at least equal to the total area of the tuyeres, and preferably one and a-half to double this.

In the outer plate of the wind belt, opposite each tuyere, is fixed a sight-hole fitting for observation, provided with a loose lid which enables the tuyere to be cleaned when necessary. In the bottom of the wind belt, and opposite a tuyere, a hole can profitably be arranged, 3 to 4 in. dia. and covered with a renewable lead disc, held in position with a ring casting and studs. This fusible disc is melted by the metal or slag, if allowed to get too high in the cupola, and through the tuyeres, and gives notice to the furnaceman to tap out before the wind belt is choked or damaged. The other necessary fittings on the wind belt are a blast-pressure gauge, provision for periodically attaching a volume-gauge, and hand holes in the outer plate of wind belt near the bottom to facilitate cleaning out the dirt which collects there. These hand holes should perhaps not be described as necessary, but as a useful addition.

Blast Pressure.—While the blast volume must be constant for each grade of iron melted, ordinary grades of cast iron can be melted at almost any blast pressure. By using a high-pressure blast, more coke is consumed per hour per sq. ft. of the melting zone area, and therefore the pressure at which the blast is supplied materially influences the rate of melting.

When deciding the blast pressure, the class of the casting required and the life of the lining are the chief considerations, as high pressure gives a higher temperature in the melting zone, with more rapid melting, harder metal, and with a greater burning or wear of the lining.

For general work the author recommends as suitable, the following blast pressures:—For cupolas of less than 3 ft. external dia., 10 oz.; for 3 ft. but less than 4 ft. dia., 10 to 12 ozs.; for 4 ft. but less than 5 ft. dia., 12 to 14 ozs.; for 5 ft. but less than 6 ft. dia., 14 to 16 ozs.; for 6 ft. but less than 7 ft. dia., 16 to 18 ozs.; and for 7 ft. and including 8 ft. dia., 18 to 20 ozs. pressure. The higher pressures are necessary in the larger cupolas for maintaining a practically even pressure to the centre of the bed.

While it may not be incorrect to speak of the blower as producing so many cub. ft. of blast at a given pressure, it is less misleading to speak of this as producing so many cub. ft. against a given resistance, as this resistance has to be produced in the cupola, or the pressure cannot be maintained.

Tuyeres.

A further important point is that obviously for uniform working. It is necessary to maintain a constant blast volume at a uniform pressure, and this pressure is produced by the resistance of the charge in the cupola, plus the resistance in the tuyeres. The resistance in the cupola charge will vary directly with the height from the tuyeres to the charging hole, the cupola being kept charged to this point. If the volume supplied is kept constant, and the resistance in the tuyeres will vary as their total effective area, as is illustrated in Fig. 2. To produce a substantial resistance in the tuyeres these would have to converge to a small diameter, where the blast enters the bed.

This would be most marked in a large cupola, with a large charging hole, where a relatively high pressure is required, and, further, all cupolas with different heights of charging hole would require different diameters of tuyere-outlets accordingly.

A converging tuyere is, however, bad practice, as the area of the outlets is soon reduced with chilled slag, which either reduces the volume or increases the resistance, according to the type of blower used, causing a constant variation in working conditions throughout the blow as the tuyere is restricted or cleaned.

Regular working conditions, therefore, can only be obtained by producing all the necessary resistance in the cupola charge. This is done by having the charging hole at the correct height, and by using splayed tuyeres of ample area for the blast required, so that partial slagging does not interfere with the effective area. The chilling of the slag is also reduced to a minimum, by thus spreading the blast over a larger area of the bed.

Cupola Wells.

The cupola well should be designed to carry the amount of metal required before tapping out, and

the slag formed. As the well is already full of bed coke, only 40 per cent. of the total capacity may be estimated for this purpose, and this amount should not be overstated, as it means a large proportionate increase in the bed coke required.

It should be possible, however, to be able to carry at least one complete iron charge, and preferably two in the well of the cupola, to ensure a complete mixing of the metal before being tapped. The usual means of storing this amount of metal before tapping is by the use of a receiver, a representative type of which is shown at D, Fig. 1, from which it will be seen that the depth of the well in the cupola can be cut down to a minimum, thereby reducing the bed coke to a minimum, and no coke being present in the receiver, ample storage capacity for molten iron can be obtained.

Better working conditions are also obtained in the cupola by the use of a receiver, as the slag runs straight from the cupola into this, and does not gradually choke up the bed coke, as in the cupola without receiver, where the slag is carried up and down through this, as the metal is tapped and held.

Cupola Types Discussed.

The essential difference between the type as shown at A and B and that shown at D and C, Fig. 1, is that the former have a straight-lined internal diameter and the latter has a lining reduced at the tuyeres, with a tapered part in the melting zone. This means a large internal diameter in the bottom in A and B, and the required capacity for storing metal is obtained with a very shallow well, necessary in this case to keep down the weight of bed coke required.

In cupolas of type C and D, with a reduced internal diameter, a higher well is required for the same capacity, and this leads to the difference in the two designs. In A and B the tuyeres are set so low that there is no room between the bottom plate and the underside of the wind belt for the fettling hole, slag, and tapping spout, and the wind belt is therefore carried right down to the drop-bottom-plate, and archways are cut through this for the fettling hole, etc.

In cupolas C and D, with the deeper well and higher tuyeres, the wind belt is self-contained and fitted above the fettling holes, etc., where it is less likely to be damaged by being burnt, and forms a more robust construction.

In type A a thicker lining in the melting zone is embodied, but the internal wind belt is a doubtful feature, as no advantage can be obtained by attempting to heat the blast at the expense of heat radiated from the bed or the melting zone. The main object is to conserve all the heat possible in this region, and a thicker lining should be used if there is any appreciable radiation here, and any heat used for heating the blast should be drawn from the waste heat delivered above the charging hole.

An internal wind belt is also open to the disadvantage that any leakage of wind will be inside the cupola and behind the lining, where it is difficult to detect, and would cause considerable trouble if it found its way to the slag-hole or tapping-hole.

In type B a single row of tuyeres is used with a practically continuous tuyere opening inside the cupola. While good results can be obtained with a single row of tuyeres in a large internal-diameter cupola, the author is of opinion that this practice is not satisfactory when applied to a cupola reduced at the tuyeres as in types C and D. The guiding principle is that, provided the correct amount of blast is supplied for burning the fusion coke, the only other object is to distribute the blast over a sufficient area of the bed as will prevent the chilling of the slag.

In types C and D the natural form of lining is used, with a thicker lining in the melting zone and a reduced area of bed at the tuyeres. This brings the blast nearer the centre of the bed, and a lower blast pressure can be used than in A and B. With this arrangement a double row of tuyeres is required to distribute the blast over two cross-sectional areas, the blast entering through the bottom tuyeres being highly heated before mixing with the cold air entering through the top tuyeres. A double row of tuyeres has also this further advantage that the top row can be shut off if the melting zone is allowed to get too low, which lowers the normal height until this is remedied.

In conclusion, cupolas A and B have a further disadvantage compared with types C and D. The drop bottom doors are large and cumbersome to handle, and more sand and time are required to make up the bottom, and the only advantages offered are that the height of the melting zone relative to the bottom of the cupola is reduced. This reduces the height of the charging hole correspondingly, and the molten iron in the well is stored a little nearer the melting zone, which is the hottest point in the cupola.

The German Iron and Steel Industry.

It is reported that a financial group composed of Luxemburg, French and Belgian interests is in negotiation for the acquisition of the majority of the shares in the Becker Steel Works Company of Willich. Prominent Luxemburg interests were formerly connected with the Becker undertaking, and it is assumed that it is now desired to resume these relations. The Company owns iron-ore mines in operation in Luxemburg, and its works lie in the area of Belgian occupation, as also does the big Friedrich Heinrich Colliery. It is also said that an American group desires to gain an interest in the concern through a Dutch financial firm.

The Friedens mine and the Friedens works of the Upper Silesian Railway Requirements Company now form part of Polish territory, and the Company's coal basis has thereby been curtailed. The directors have now decided to acquire the majority of the shares in the Donnersmarckhütte, whose mines and works continue in Germany, and which will be able to restore the lost coal basis for the Gleiwitz and the Zawadzki iron works.

Herr Hugo Stinnes and the Austrian Alpine Montan Company, together with the British Hungarian Bank, have formed the Ferro Company at Pesth with a capital of 10,000,000 Hungarian crowns, and the South Slavian Montan Syndicate at Agram, for the purpose of promoting the sale of the products of the Austrian Company and of those of the Rhine-Elbe Union, in Hungary and the Balkan countries. A similar sales company is also shortly to be constituted for the Rumanian market.

The Hugo Stinnes group has concluded an agreement with the Leptak (Hungarian) Iron and Machinery Company under which the share capital of the latter will be raised from 100 to 180 millions of Hungarian crowns, and 80 per cent. of the increase has been taken over by the former. Besides Herr Stinnes, representatives of the Deutsch-Luxemburg, the Gelsenkirchen, and the Bochum Union Companies become members of the board of the Leptak Company, which will now also promote the export trade.

Company News.

A summary of the financial results of various companies in 1921-22 is given below in marks, the figures for the previous year being shown in parentheses :—

The United Königs and Laura Works.—Gross profits, 96,500,000 (34,580,000); net profits, 80,333,000 (22,040,000); placed to reserve funds, 62,800,000; dividend at rate of 30 per cent. (10).

Menden and Schwerte Iron Industry Company.—Written off for depreciation, 218,000 (761,000); net profits, 2,750,000 (2,960,000); dividend, 25 per cent. (25).

The Bosperde New Rolling Mills Company.—Net profits, 4,500,000 (1,500,000); dividend, 50 per cent. (30).

Carlsruhe Machine Construction Company.—Net profits, 28,440,000 (10,960,000); dividend and bonus, 50 per cent. (30).

Sir W. G. Armstrong, Whitworth & Company, Limited, have taken up the manufacture of steam and oil road rollers and other road-making machinery, including drying and mixing plants.

"White Iron Ore."—Privy Councillor Krusch, at the recent German Geological Congress, communicated the results of his investigations of the diluvial iron ore to be found in the extensive peat bogs in North-Eastern Germany. The peat is mingled with a whitish clay, which contains a considerable percentage of ferrous oxide. The author is studying the question of how this large source of iron ore can be utilised on a commercial scale. In the meantime he proposed the name of "white iron ore" for the deposit.

Institution of British Foundrymen.

LANCASHIRE BRANCH.

Mr. Haigh's Presidential Address.

At a meeting of the Lancashire Branch, held in The Manchester College of Technology on Oct. 7, Mr. J. Haigh delivered the following presidential address :—

Gentlemen,—In addressing you this afternoon I do so with a great deal of pleasure and with a certain feeling of diffidence. I consider it a great honour for any person to be the President of the Lancashire Branch of the Institution of British Foundrymen, and can assure you of my appreciation of the honour you have done me in electing me to this office.

Evolution of the Modern Foundryman.

Foundry work is always fascinating, even if it is accompanied by a certainty of worry. Undoubtedly the art or craft of a foundryman ranks very high, and it is the duty of all to see that the standard is maintained. Unfortunately, and for some inexplicable reason, the foundry industry until recently did not attain that status to which it rightly belonged, and in thinking over this matter, one is rather driven to the conclusion that the neglect was probably due more to the foundryman himself than to any other cause, and probably one reason for this was the Bohemian character of the old craftsman.

Founding is more of an art than any other of the industrial operations, and whilst the older craftsmen were real artists much of the same spirit remains to-day. The glorious uncertainty connected with the making and casting of a mould, calls forth qualities which a merely mechanical operation, however intricate or clever cannot produce, and I wish to make an appeal to all interested in founding to cultivate and develop the artistic and imaginative side of the business, particularly amongst the younger men and boys.

At the present time, when everything tends to become automatic and mechanical, the art and craft of founding stands apart and refuses to be coerced, and it will be a long time before the complete making of a casting becomes a purely mechanical affair. It is granted that the production of certain types of castings lend themselves to mechanical methods, but we have not yet arrived at the stage where the skilled moulder is looked upon as a curiosity and out of date.

After a mould is made, there is the pouring or casting to consider, and it must always be remembered that a mould is tested by the actual pouring of metal. Many a nice-looking mould has been spoiled by the metal.

Recruiting Personnel.

Much has been said about the failure to attract boys into the trade. It is our duty to represent the trade in its true light. Though there are many objectionable features and much that is uncomfortable in the business, it is not at all sure that these things constitute the real reason why there are not more applicants for situations. We are paying the price of neglect in the past, due to influences both inside and outside the foundry, which looked upon the foundry as a place of evil reputation, of bad smells, and bad language, and to which a lad went when he could not get a job elsewhere, or as an accident.

Growth of Foundry Science.

We are suffering from a lack of imagination which originated 20 or 30 years ago, or probably longer, and about that period when the founding industry in this country touched its lowest depths socially, the minds of men were moving, as they ever do, towards higher things, and time and the need produced the men. So in 1904, nearly 20 years ago we find a small number of men deeply interested in the conditions then prevailing and desirous of improving both the technical and scientific as well as the social side, meeting together to discuss ways and means, and from that meeting came the British Foundrymen's Association, which in fullness of time obtained a Royal Charter, and is now the Institution of British Foundrymen, an organisation which has done more to enlarge our vision and to re-create the craft than any other cause.

When we examine the improvement on the purely scientific side, the results are remarkable, and whilst a chemist, and particularly a chemical laboratory, were regarded as a luxury twenty years ago (and in many cases are to-day) we now regard them as being necessary to the regular and accurate production of castings metallurgically. The increased interest taken in metal mixing, sands and facings, and the information available, indicates the progress made. We are well aware that the laboratory cannot tell us many of the things we would like to know, and in many cases does not give the assistance desired; this is often due to the lack of practical experience on the part of the chemist, or to lack of appreciation and inability to use the information available on the part of the practical man.

The lines of demarcation are however growing less, and both sides are being forced together in the common good of the whole.

Advancement has also taken place in other directions. The increasing use of moulding machine[illegible] which has enabled us to maintain and increase [illegible]oduction in spite of many adverse conditions, s[illegible]ows that the foundry industry generally is now alive to the advantages of machinery, particularly that type of machinery which makes it possible to obtain increased output, with less fatigue for the workman.

Available Craftsmen.

The fallacy " that the introduction of machinery means the reduction of the number of skilled men employed," has been completely exploded in the foundry, and in normal times (present times being abnormal) the number of skilled moulders available is not too great for requirements.

What has taken place, and probably will do so to a greater extent in the future, is the grading of workmen, that is, the highly-skilled moulder will do highly-skilled moulder's work, and those of lesser skill will do the less skilful work, and it will be possible to find work for them according to their ability.

I should have liked to speak upon the education and training of young foundrymen; the subject has, however, been recently dealt with by Mr. A. A. Liardet, the West Riding Branch President, I will content myself by asking you to read his very excellent paper, entitled " The Training of a Foundryman," in which he goes into the subject in a very comprehensive manner.

The subject of training is a very difficult one, and as an Institution we must not forget that the future of the industry rests with the trained and educated man, and no effort should be spared to induce the younger men in our ranks to undergo the necessary training and hard work which is essential to success. I should like to see a serious paper written upon the Training of Foundry Foremen. I am personally satisfied that the higher administrative positions in our foundries will be most satisfactorily filled by the highly trained practical men, rather than by the purely scientifically-trained men.

What is Being Done at Present.

As many of you are aware, committees have met to consider the important question of test bars, and a good deal of work has been done. At the moment their work is not completed, but it is hoped before long, as a result of their labours, to standardise tests and test-pieces and to place the whole question upon a more satisfactory basis for all concerned.

The year 1921-1922 has been noteworthy for our Institution for many things, and so far as this branch is concerned one event in particular, I refer to the gift of the " Oliver Stubbs " Medal, and its first award.

Those of you who have studied the figures relating to the Institution will find that in 1904, the year of its inception, we had 38 members. This year, 1922, we have a total of 1,505, truly a creditable record.

The three outstanding features of the year are:—(1) The granting of the Royal Charter; (2) the gift of the "Oliver Stubbs" Medal; (3) the Foundry Trades Exhibition held in Birmingham.

So whilst we are apt to belittle our accomplishments and to speak with becoming modesty, the work goes forward and we find something has been done.

When Mr. Robert Buchanan, in June, 1918, read a paper at the Sheffield Conference upon a "National Information Bureau for Foundrymen," I do not think he anticipated that within the next three years the nucleus of such a bureau would be in existence, and yet such is the case.

The paper met with a certain amount of criticism, not as to the advisability of a bureau, but as to who should finance it and undertake the work. With the formation of the British Cast Iron Research Association, the question was to a certain extent solved, as such a bureau became one of the first necessities.

I quote this case merely to illustrate the point that progress is taking place and that many of the things desired are being slowly attained.

The formation of the B.C.I.R.A. will, if proper support is fothcoming, prove a great help to the ironfounding industry, particularly to the smaller firms who cannot carry out any extensive research of their own, but who need the best information available. It will be the privilege of the larger firms to help financially. I trust all our Members will give thoughtful consideration and support to the Association, as it is only by co-operative effort that an Association of this description can be successful.

What of the Future?

I am aware that the present time is a very difficult one, probably the most difficult and critical time that the industry has ever known. Great courage and patience are needed if we are to come out successfully, and I believe these qualities are being manifested every day by those in charge. The end of the hard road is not yet in sight, but it is up to all of us who have any power or authority to use it wisely and soberly. If we do this the Institution will render good service to the founding industry and to the country generally.

From the few figures which I have given you, you will appreciate the growth of the Institution which has taken place, but we have not yet reached our highest desires.

Considering the work done for the founding industry, I do not think it unreasonable to put forward the suggestion that we ought to have at least one member in every foundry.

When this is accomplished we shall be able to go forward to the attainment of many of the ideals for which this Institution stands.

I trust during the coming year the gloom which now hangs over our industry may break, and that the warm sunshine of prosperity may appear again to all of you.

Vote of Thanks.

MR. O. STUBBS, in proposing a vote of thanks to Mr. Haigh for his address, said it was of the kind which he anticipated, containing many practical suggestions. With regard to future developments it was not necessary, nor desirable, that new societies should be formed to do work which came within the province of the Institution. It should also be kept in mind that the object aimed at was the education of the practical men in the shop who did the work, and they should be taught in language which they understood. Much good would be done by holding joint meetings occasionally with kindred Associations, for instance, the Manchester Association of Engineers. He also thought something should be done to obtain new members, in spite of the bad times. There ought to be more members, and they would soon be got if, as he had said before, every member would make it his business to bring in someone else. Very often when the nominations were examined it appeared that this work was left to a small circle. As far as the General Council were concerned, they would be delighted to do anything in their power for the Lancashire Branch.

Mr. Sydney Smith seconded the vote of thanks, which was passed unanimously.

COVENTRY BRANCH.

At a meeting held on October 4 Mr. G. E. Roberts delivered the following address:—

Presidential Address.

GENTLEMEN—

In considering the question of accepting the presidency, I could not help feeling my own limitations for the office, especially when considering the achievements and technical knowledge of the previous presidents, and I feel I can hardly do better than to give a few random thoughts on foundry work in general, hoping that the restraint that has usually followed presidential addresses may be cheerfully abandoned, and lively discussion followed on any interesting points that may be raised.

Compulsory Technical Training of Foundry Youths.

The first thought that comes to my mind is the difficulty experienced by most foundries in connection with the training of boy labour. It has not been my experience that there is any real difficulty in securing such labour willing to take up foundry work under ordinary rule of thumb methods, but there is a general unwillingness of youth in foundries to take up the study of foundry work in its more technical aspects. The reason is not far to seek, but nevertheless an effort to effect a remedy should certainly be considered. In the first place the arduous work connected with foundry life can hardly be expected to appeal to the more refined and highly educated youth. The dirty work and heat make no appeal to such, and the type of young worker that comes into the foundry is the ordinary boy who merely wants a job, and finds himself more or less accidentally in a trade to which he has given no serious thought. For such as these—and we must take the foundry youth as we find him—I am of the opinion that compulsory training of a more technical character should be given than could possibly be acquired in the workshop only. It can be truthfully stated that there are many difficulties surrounding such a problem, but there must of necessity always be difficulties to overcome before success can be achieved in any phase of life; and it can be proved that in other countries scientific training goes hand in hand with workshop experience, however humble the circumstances of the worker may or may not be. In Germany, at any rate prior to the war, every young worker engaged in a trade was compelled to study the theoretical side of such trade during working hours.

Such training, in my opinion, should either be a charge on the industry concerned or the State itself should make some provision whereby such knowledge may be gained by the young foundryman. Such an arrangement would, in my judgment, prove of inestimable value to the industry in which we are all interested. It would in time give us fewer waster castings, because the worker would have acquired knowledge quite beyond that possible in the mere manufacture of castings by rule of thumb, and the higher degree of skill of the moulder would be a great gain in trade prestige. This would inevitably result in the trade making a wider appeal to boy workers of higher preliminary education. I think that the higher the competitive skill in any trade the wider the appeal such trade makes to those seeking an interesting career.

I very much regret that the old system of indentured apprenticeship is not more in vogue. If it were, there would be less difficulty in getting employers to stand the cost of boys' time spent in technical training at local schools. In my judgment the cost of providing education necessary to make a youth technically proficient in his trade should be borne by the State, and the payment for time lost in so doing during working hours should be borne by the employer. No employer, however, could be expected to carry the cost of so doing unless there were some guarantee that the youth would not immediately leave his employ when trade improved, and labour scarcity enabled some competitor to make a higher bid for the boy's services. Wages should therefore be stabilised according to age without excluding merit bonuses.

Such training schools as may be devoted to the education of the young apprentice should be

equipped for the purpose of proving technical statements, with a moderate amount of tackle for practical demonstrations. In addition I would strongly urge that all educational establishments be provided with technical libraries, to which free access and borrowing leave be given to all scholars interested in their contents.

Patternmaking Defficiencies.

I cannot help thinking that the worker in this branch of foundry work is not so well trained as he should be, considering the length of apprenticeship which has to be served before the patternmaker can be considered efficient. While I do not wish to emphasise glaring blunders in patterns, such as undercuts and tapers cut in the wrong direction, I would draw attention to the insufficient knowledge which patternmakers seem to have of the various metals of the casting for which patterns are made. It may be that the malleable foundry business is particularly unfortunate in respect to patterns which come its way, but it is frequently found that there are sharp right angles instead of the pattern having a good radius or fillet, making it impossible to produce castings without searing until the necessary fillet is provided by waxing up the patterns, fitting leather fillet or trowelling the mould after withdrawing the pattern.

Another grievance which foundrymen have against the patternmaker is caused through his inability to decide where certain types of castings should be run. The considerable contraction and heavy section of some castings which we have to manufacture make it imperative that we arrange large feeding knobs to insure soundness in the centre of some of these heavy sections. Yet we often find that the patterns are so made that we ourselves have to make metal pattern run-offs, and practically do the patternmaker's work all over again. It seems to me that the only possible way in which a patternmaker can be expected to be fully proficient at his trade, and by this I mean capable of producing patterns which will work without alteration when put into the hands of the moulder, is for patternmakers to have a definite period of training in the foundries during the period of their apprenticeship.

Another little trouble which we have is with respect to cores not being made self-centering. In the majority of patterns core prints are left precisely the same diameter as the cored hole. In the case of vertical cores, when the moulder places the top half of the boxes in position, there is no automatic method of making the vertical core locate itself centrally in the top print; and the cored holes come out of position through it being a poor fit, whereas a taper print would guarantee that this trouble would be obviated. A taper print prevents any sand being brought down when closing the boxes and guarantees a centrally placed core. When speaking of taper I refer to a much larger degree of taper than is usually considered sufficient by the patternmaker.

Balancing Prints Require Study.

Another grievance relates to the subject of balancing prints; and this is so important that I would commend the matter to the favourable consideration of patternmakers at large. The majority of balancing prints are extended outwards to such an unreasonable extent that the number of patterns which can be placed in a given size of box is considerably limited. If such balancing prints were shortened and widened the balancing effect would be the same, and the number of castings which could be placed in a given size of box would be considerably augmented. It will be readily admitted that the greater the number of patterns that can be placed in a box the lower the productive cost of the castings. It is really surprising that this detail has not received more consideration from the patternmaker, because while it may mean a little more work for him, the cost of producing castings is thereby considerably lower. There also are instances where prints are forgotten altogether. For instance, the pattern exhibited is painted at one end and, judging by the core box sent, the core is intended to cut through the lower end of the pattern. The pattern is not painted to represent the core as cutting through, and with the core box sent is in its present form unworkable.

Too many Core Boxes Provided.

Another weakness in patternmaking is the desire for making core boxes when considerable reduction in foundry costs could be secured if core boxes were cut out, and patterns made to leave their own cores. One quite realises that patternmakers, like other tradesmen, like to secure as much work as they can; but there is no doubt that many hundreds of pounds are wasted annually because there is not more co-operation between the foundry and the pattern shop. It may be argued in this connection that whereas dispensing with the cores would necessitate taper on patterns and other alterations, this argument cannot outweigh the great gain in cost of manufacture and the reduction of scrap where cores can be dispensed with.

Competition from Drop Forgings.

I should also like to make an observation with regard to the question of increasing taper where core making is avoided. Experience has shown that in some cases where stampings have taken the place of malleable castings, the buyer has been willing to accept stampings with a very large taper, because he cannot get them otherwise, but he would certainly refuse castings with an equivalent of "leave." Why concessions are given to stampers and drop forgers which are denied to foundries is difficult of explanation.

Reducing Coreing.

Another suggestion which might be remembered by patternmakers is the desirability of reducing the number of cores handled, by making core prints and core boxes for the purposes of coring up two or more patterns of identical shape. For instance, one pattern was intended to be used in a 20 in. x 11 in. box and to take 40 patterns. As intended by the patternmaker, two cores were necessary for each pattern. This entailed the making and placing of 80 cores per mould.

It is suggested that to work this job in a more economical way it might be handled in a small box, say of 14 in. x 11 in., which would accommodate 36 patterns. These patterns could be sprayed in sets of three. The flat core and long straight core could all be produced in one core-box, from which it will be seen that the coremaking would be reduced 66.6 per cent., or, in other words, 12 cores would core-up one mould, whereas, as submitted, 72 cores would have been required for each mould containing 36 castings. It would also be certainly quicker to make the cores in sets of three than to make six separate cores for three castings.

Another pattern which we ourselves altered in this way, with excellent results, from the saving in cost of production standpoint, was cored up, two core-prints with one core, thus avoiding the need of balancing prints, which would have taken up very useful room in the moulding box.

More Hints to Patternmakers.

There are several other minor points to which I wish the patternmaker would give attention, and one of them is the more detailed marking of patterns relative to the machining operations after the castings have been made. These markings are of considerable importance to the foundry, as will be seen. For instance, nowadays, the machining operations are cut down to a minimum, and there are many cases where merely a disc-grinding operation is performed, and this means of course that there must be no taper or leave on the surface which is to be disc-ground. But how is the foundryman to know this without the pattern being so marked, or unless he has a blue print with machining instructions before him?

Foundrymen are so accustomed to milling and planing operations where "leave" is not of much importance that they often get into trouble where castings are merely disc-ground, because this is not clearly shown on the pattern when received, and the trouble only becomes known after the castings have been delivered, and machining is started on.

A similar point might be made with regard to cored holes. Some cored holes are merely cleared by drilling or reamering, and naturally drills or

reamers follow the lead of the hole itself, and therefore the utmost care in laying the core has consequently to be taken. This is particularly difficult, as previously shown, especially when the core-print is not sufficiently taper to ensure the core centralising itself. If, on the other hand, the hole were to be machined by a boring bar, any slight variation in the position of the hole could be quickly taken up and rectified by means of the boring tool, and castings which might otherwise be scrapped could be passed through, if the nature of the operation were known to the foundry.

Marking Patterns.

It should be superfluous to plead for the proper marking of patterns, but it is a most frequent occurrence to receive patterns which bear no indication as to whom they belong, and such patterns are usually unnumbered. To illustrate the problem, we might receive, as we have within the last few days, 20 unnumbered and unnamed patterns, say motor cycle patterns, without any indication as to what the various parts are, and then in a few days someone will ring up asking how a particular part is progressing. It is quite impossible to give any information, and the inquirer thinks the foundry people are hopeless, whereas his own lack of businesslike methods are at fault.

I should like to make one plea with respect to particular patterns where the malleable foundry industry is concerned. It is common knowledge that after the castings are made—and here it is claimed that malleable castings are more difficult to make than any other—our difficulties are only just beginning. The annealing treatment often leads to warping and distortion of castings, either through defective design or packing, and this trouble might in many cases be considerably eased if webbing pieces were provided to prevent the arms or other parts of the castings offset from the main body of the casting from warping. As an example, it is found in modern design various instances where the machine shop is considered in their various difficulties, and we certainly think the time has come when some consideration should be given to the troubles of the foundryman.

Ladle Daubing.

Another feature which should be removed is the necessity for continual daubing or lining iron and steel ladles. It seems to me that it should not be beyond the skill of the various research organisations to get over this problem. The ordinary plumbago pot is too expensive for work except in connection with pot furnaces, and I therefore look forward to the time when it will be possible to line ladles with some refractory material which will stand up with some degree of permanence in contrast to the daily daubing.

Foundry Text Books.

I should also like to allude to a matter referred to by Mr. Reason in his remarks at the annual convention in Birmingham, with reference to a foundry text book, containing formulæ and general information relating to foundry work. Such a guide should be in every way equivalent to the pocket Molesworth, which is now so indispensable to the mechanical engineer. There need be no limit to the value of such a book. It should include details of mixtures for both ferrous and non-ferrous castings, and should give particulars of the various tensile strengths which such mixtures should give. It should also provide information with reference to the various melting points of different metals and combinations of metals. Admiralty and War Office specifications and tests theoretical and analytical should not be omitted. In fact, it should be so comprehensive that the foundryman may have at hand such technical information as will enable him to conduct experiments without having to cover a deal of preliminary ground which such a *vade mecum* would give.

The needs of the foundry trade in respect of the general dissemination of knowledge are perhaps more pronounced than in any industry of similar importance. Where can we find the compendium of information which will help to guide the foundryman in the selection of sand, limestone, coal dust, etc.? One is aware by way of practical experience that some sands are more suitable for some castings than others; but what is really needed is a more detailed classification of sands most suitable for casting particular classes of metal. The same remarks apply to limestone, with regard to which there seems to be very little interest displayed even by those firms and chemists that have every facility for research.

Coal Dust.

It is also surprising that coal dust, too, has not been the subject of more general discussion in foundrymen's meetings. The quality of coal dust varies enormously even when obtained from the same suppliers, and the variation causes such divergent results that here again one marvels at the general apathy appertaining to the subject.

It will be argued that I am here pleading for something which is beyond the range of practical politics at the present time, but there is no doubt that such information does exist which, if duly set forth in a foundryman's guide or such a book as has been suggested, would prove of inestimable and lasting benefit to the trade. Of course, such tests as I have hinted at need not be confined merely to the elements mentioned, but might include plumbago, parting sand, mould dressings, and the like.

In passing I might say that the Coventry Malleable Foundry has had excellent results with parting powder made of simple coal fire ash, carefully screened, and passed through a dusting bag.

Composition Tests.

Many firms, especially the smaller ones, are unable to go to the heavy expense of taking regular chemical analyses, much less support a laboratory of their own; and it would be extremely useful if such firms were in a position to take rough and ready tests of the metal tapped out. The same remarks apply to slag, which oftentimes provides a useful hint as to the silicon content. For instance, one of my predecessors has stated, if not from this table, to me personally, that green coloured slag is an indication of a safe silicon content so far as malleable iron is concerned.

Another useful indication of a silicon content is when the metal, although tapped out thoroughly hot from the cupola, suddenly becomes pasty. All such hints would be exceedingly useful if included in the foundryman's notebook.

Perhaps someone could suggest or knows of a rough and ready method of arriving at the sulphur and phosphorus content. It has been suggested that an excess of sulphur betrays itself in a scaly or pitted appearance of the runner heads, but as this suggestion has been put forward by someone interested in an anti-sulphur compound, it is desirable that confirmation should be obtained.

Might I be permitted to allude to one of the difficulties in the malleable foundry business, namely, the trouble with hardness. It is generally thought that a drilling test is the last word One Coventry machining shop has installed a device for testing the rapidity of drilling castings, yet we find that occasionally we get castings which give excellent results on a drilling test, but fail when being milled or planed. It has been suggested that an improved piece-work price for the machinists often makes the castings softer, but what we want to have is some perfect test which will remove every possible doubt as to machine qualities before castings get out to clients.

Blowpipe Examination of Refractories.—In the course of his Paper on "An Examination of Refractories by the Oxy-Hydrogen Blowpipe," read before the Ceramic Society at Birmingham, Mr. A. L. Curtis explained the appliance as being particularly well adapted for quickly examining the properties of refractories, especially for small quantities. Coal gas or acetylene could be used, but for small pieces acetylene is difficult to control. The refractory, in the form of powder, is mixed with water or with a watery solution of dextrine. The test is checked by the use of Seger-cone mixtures, similar to the refractory test pieces, and the number of seconds required is noted. A camera is used to record the changes, in conjunction with microscopic objectives, telescope objectives, etc., and the effect is watched all the time on a screen. Effects produced on several Scotch products were described. Blistering produced on test pieces of bauxitic clay was ascribed to high titanium oxide content.

What's Wrong with the Foundryman?

A few years ago the foundryman was continually "grousing." He complained bitterly that there was nothing being done to improve the status of the foundryman or his craft. Whilst then all other branches of the engineering trade were advancing rapidly by the application of education, science, and research his grumbling was quite justified, but not now.

The scientist, academician, and metallurgist are all doing their utmost to enlighten the foundryman in the fundamental principles which both underlie his craft and promote the studies of its higher branches, with the definite purpose of helping him to make less wasters and better castings by broadcasting knowledge. Instruction in foundry work in all its aspects is now available in most of the important centres, and there is a plentiful supply of foundry literature. Universities, colleges, technical institutions, etc., all open their doors to the foundryman, and the Chartered Institution of British Foundrymen exists for them. Yet, what do we find? Do we find him embracing any of these unique opportunities? No. Do we find a good attendance at any of the meetings or lectures? No. Do we find a desire in the foundryman to fit himself for the higher and more remunerative positions? No. Yet he wonders why it is when he tries to obtain one of the higher positions that he fails.

It is very distressing to see so little desire to take advantage of any of the modern practical or scientific educational movements, so little desire to improve himself, or to lift his ancient and wonderful craft out of the slough of despond. No, he seems quite satisfied to jog along with his nose in the sand all day, and to sit at home picking out the winner (?) from the sporting papers in the evening.

Small wonder, then, that we find clerks, engineers, patternmakers, non-technical men of all shades occupying positions of trust which undoubtedly ought to be filled by foundrymen.

Quite recently a lecture was given by a very able metallurgist, at a great expenditure of money and time, and a more instructive and helpful lecture has seldom been delivered. Yet there were only about 40 attended, and not all foundrymen at that. Such a state of things is appalling. We may well ask, "What's wrong with the foundryman?"

Is it there are too many counter-attractions—football, betting, cinemas, billiards? Of course, all these pastimes are excellent, except betting, in their place, and very necessary to a certain extent, but when they absorb all the leisure time and thought of the foundryman to the total exclusion of all educational movements, then they are decidedly detrimental to progress.

There is, perhaps, another reason for the foundryman's lack of interest in his work, *i.e.*, apathy, and this is the worst of all, for it leads to despair. Despair leads to despondency, and this means giving up of all hope by the weakening of the intellect. Can anyone imagine a worse state for a mind into which to drift?

There will be no doubt of the result; there will be no misgivings as to the future success of the craft *if* the foundryman will only wake up; if he will make an effort; if he will make an honest endeavour to cross the road and see what the other fellow is doing. Then he will not readily leave the path of investigation and research.

The foundryman can do quite as important research work in the foundry as the academic gentleman can in the laboratory, and in a very short time these theoretical gentlemen will realise there is more in foundry work than making a hole in the sand and pouring the metal into it to secure a good sound casting.

Is it to be inferred by this apparent neglect of all educational movements by the present-day journeyman moulder that there is no hope for improvement in him? Or is it to be understood that he has reached that stage of perfection when he regards all educational movements as superfluous? If the latter, then let him remember there are hundreds of his fellow craftsmen who will regard him as a great benefactor to the craft if he will only come forward and impart some of his wonderful experience to them.

Of what use will all the extensive attainments be when he shuffles off this mortal coil? One very encouraging feature existing to-day is the attendance of so many boys and youths at the classes and lectures, eager to embrace each opportunity as it arises, and in this they must be encouraged in every possible way, so that in the next decade it shall not be asked, "What's wrong with the foundryman?"

J. E.

Iron Ore Crisis in France.

The statistics published in France at the end of August show an increase in the exports of Lorraine ore to other countries, including Germany, Belgium, and the Saar, the exports in the first half of 1922 having increased by 85 per cent. over those in the second half of 1921. Nevertheless, the future of the ore production in the East of France, according to M. A. P. in the Paris "Information," remains disquieting. The situation in the Briey district, which seems to have escaped public attention, continues to preoccupy the interested parties. Recent statistics show that the output in that district had fallen off from 15,204,000 tons in 1913 to 621,000 tons in 1919, but recovered and rose again to 3,466,000 tons in 1920. Similarly the output in the Longwy Basin declined from 2,878,000 tons in 1913 to 688,000 tons in 1919, rising to 714,000 tons in 1920. The output in the Nancy district receded from 1,897,000 tons in 1913 to 670,000 tons in 1919, and reached 816,000 tons in 1920; while the production in the Thionville district, which was 21,133,000 tons in 1913, was only 7,127,000 tons in 1919, falling further to 6,029,000 tons in 1920. Moreover, production in 1921 was equally disappointing. The gravity of the situation is further proved by the fact that the number of miners employed on both sides of the old frontier in Lorraine, which totalled 34,640 in 1913, declined to 18,826 in 1920, and further to 15,428 in 1921.

Despite the greatly reduced production the stocks of ore at the mines increased from a total of 3,042,000 tons for all districts at the end of 1920 to 3,515,000 tons at the close of 1921. In other words, it was not possible to find a market last year for a quantity representing one-fourth of the total annual output; in the Briey district alone the increase in the stocks was from 397,000 tons to 998,000 tons at the two year ends respectively. The industry in that region has been more seriously affected by the crisis than that in the other centres of ore production, and matters have gone so far as to foreshadow a possible collapse in Briey. So far these pessimistic prognostications have not been fulfilled, but the danger exists all the same. In 1921 the 18 mines in that region, which have been fully equipped at a considerable outlay of capital, were only able to show a combined output of about 4,000,000 tons, or say an average of about 220,000 tons, which is wholly insufficient to keep them going under the special conditions under which the mines in the Meurthe and Moselle are being worked.

New England Foundrymen's Association.

At the September meeting of the New England Foundrymen's Association, held at Boston, U.S.A., cupola practice was the subject under discussion. One of the features was that many foundries relied on ordinary labour to prepare charges for cupolas, and that instructions were often not adequately followed, which resulted in waster castings. The opinion was expressed that a foreman should stay upon the charging floor.

Messrs. Automatic & Electric Furnaces, Limited, have changed their address from 281-283, Gray's Inn Road, London, W.C.1, to 173-175, Farringdon Road, London, E.C.1.

The Metropolitan-Vickers Electrical Company, Limited, announce that their new season's price lists and folders are now available, and that they are prepared to overprint the name and address of any electrical contractor on a supply of this literature at his request.

Electric Furnace Operation.

By Walter Scott.

Undoubtedly the electric furnace from the metallurgical standpoint permits more homogeneity and flexibility in the application of processes and varieties of product than any other steel-making furnace yet devised; the chief characteristic being absolute control of temperature and slag conditions during the melting and finishing period. The flexibility of the electric furnace requires a thorough knowledge of essential principles on the part of the operator, because he must be able to apply any one of them. Lack of adequate knowledge of the operations involved has in many instances led to abuse of the electric furnace, whilst certain mechanical and electrical weaknesses have jeopardised the successful operation of many furnaces. However, properly made electric steel is undoubtedly superior to other grades of steel, close control of the elements ensuring a product of chemical purity with great density and good physical properties.

The installation of an electric furnace should not be carried out before a close study of economic conditions such as the cost of electricity, amount of power available, position for freights, costs of labour, etc. In operation, records should be kept of units consumed per ton of steel produced, raw materials, refractories consumed, wear and tear on moulds and other operating details. Close attention to these items should enable the electric furnace to compete favourably with the open-hearth in some classes of steels. In special steels the electric furnace will undoubtedly hold its own, and is more and more replacing the crucible process.

Furnace linings are apt to differ slightly in each works according to their practice, but the fundamental principles do not differ; in the case of a basic furnace lining ordinary firebricks, or in some cases magnesite, are used on the bottom, of course the latter being more expensive, but it has been found while minimising the risk of breakouts, magnesite is liable to cause shorting on to the furnace casting If the former they must be separated by chrome bricks. The firebricks are usually taken up to the slag line, where it is essential to have either magnesite or chrome bricks from the silica bricks which continue to the roof. In the case of a bottom-current furnace, usually a mixture of carbon paste and fine chrome is used, this being rammed over the copper conducting plates.

Difficulties are largely avoided if proper attention is given to selecting suitable dolomite, carefully heating, mixing it without using excessive amounts of de-hydrated tar. Ingredients should be carefully rammed in layer after layer, care being taken that no soft patches are overlooked, as this often leads to trouble during working. The ramming is continued until the bottom and banks are complete. In the case of an acid furnace bottom this may be formed by using peanut size ganister mixed with a little tar to bind; this should be rammed and burnt in the usual manner and fettled with sand, etc. Great care is required when bricking the roof of an electric furnace owing to the weakening effect of the electrode holes. Due allowance for expansion must be made when using silica bricks. In some cases bauxite bricks have been used with remarkable success, but allowance must be made for contraction by keying them tightly together. Pre-heating should allow for the complete burning in of the bottom, due care being taken to avoid chipping of the brickwork through neglecting the temperature. In general practice it is found that a constant low temperature is preferable, this ensuring a good burning-in without risks, allowance as to period of time required being made according to the size of the furnace.

Furnace Operation.

Most kinds of scrap can be used, but if possible only the best should be employed, as this will be found more economical in the long run by not retarding the working, as is usually the case when using dirty scrap which causes undue accumulations of slag, loss of metal, and over-oxidised metal. It is usual to charge 25 per cent. of closely packing scrap in the form of shearings, punchings, or heavy turnings; also it will be found more economical when charging to distribute the light turnings round the lining, this serving to protect it during the melting period. Lime, and, if necessary, a little ore, is charged in with the scrap. After melting, and assuming that the analysis is correct and the metal sufficiently hot, the slagging operations are begun, which entails the entire removal of the oxidising slag.

This operation entails two distinct operations: —(1) Oxidation of the elements silicon, manganese, carbon, and phosphorus. (2) After making the second slag, the reduction of sulphur and any oxides left from the preceding operation. After slagging, the necessary amount of carbon is added either in the form of anthracite or coal dust, which is readily taken up by the metal. It is usual to add a little ferro-silicon, fluor-spar, lime, etc., to form the necessary reducing slag. The current is again switched on at a lower voltage, and preparations made to get the slag fluxed into proper condition for de-oxidising and de-sulphurising the metal; this condition is only obtained by careful observation of the temperature and slag conditions. It is essential that a good thick fluid slag is maintained by adding lime and fine carbon; if the slag should thicken up, a little spar will be found to be beneficial. Modern practice in killing the metal is to use the least possible amount of silicon; this is only possible if the correct temperature is maintained; nothing causes wild metal more than erratic temperatures, which disturb the slag conditions. Prior to tapping, the necessary alloys, if any, are added.

Typical Melting and Finishing Slags of a 7-ton Heroult Furnace.

Cast No.	Slag sample.	SiO_2.	FeO.	Fe_2O_3	CaO.	MgO	MnO.	P_2O_5.	S.
1	Melting	9.40	21.02	8.80	38.80	10.52	3.55	1.65	0.42
1	Tapping	30.40	0.68	—	64.00	3.07	0.22	—	0.42
2	Melting	11.70	23.04	8.00	37.40	6.99	4.70	2.41	—
2	Tapping	21.60	2.04	—	64.60	3.87	1.20	—	0.10
3	Melting	10.50	19.58	6.40	44.40	8.00	4.00	2.75	—
3	Tapping	11.40	—	—	—	—	—	—	0.27
4	Melting	13.20	13.00	5.20	48.10	7.29	4.30	1.39	—
4	Tapping	9.60	1.01	—	66.20	3.00	1.48	—	0.91
5	Melting	10.20	21.31	9.60	41.60	6.70	3.16	2.32	—
5	Tapping	13.30	1.57	—	63.00	—	1.30	—	0.80

The melting slags as referred to in the table were taken just before slagging, whilst the tapping slags were obtained just before tapping. It will be noticed that a few of the tapping slags are low in SiO_2. In these particular casts a little calcium-carbide was used to help the slag, and was found most beneficial; it appears to have a retarding effect on the loss of silicon, and in each cast it was found that the theoretical addition was more or less retained in the steel.

Swedish Iron and Steel.—The subjoined table shows the Swedish imports and exports of iron and steel, and the exports of iron ore, during August, 1922, and the eight months January-August, 1922, compared with the same periods in 1921:—

	Aug., 1921.	Aug., 1922.	Jan.-Aug., 1921.	Jan.-Aug., 1922.
Iron and steel:	Tons.	Tons.	Tons.	Tons.
Imports ..	8,770	13,083	98,648	77,324
Exports ..	9,749	15,393	77,761	100,556
Iron ore:				
Exports ..	395,525	605,555	2,956,054	3,216,197

The June figures were given in our issue for September 1.

The Selling Price of Grey Iron Castings.

By H. E. Burrell.

Many foundries have on their books one or a few customers who purchase their castings at an all-round price per cwt. These customers are either large concerns in textile and such industries who possess an engineering department for the repair and maintenance of their plant, and who are continually requiring machinery castings, or engineering firms whose producing capacity is not sufficiently large to efficiently run a foundry of their own.

An all-round price per cwt. is usually agreed upon after consideration of the varieties and weights of castings required, and so long as these are proportionately maintained, the price is fair to both parties.

In the former case, the one who purchases castings for the maintenance of his plant, it will be found that the class of work continually required is as expected, and therefore the price arranged proves satisfactory. But with regard to the latter type of customer, this is rarely so. The castings required eventually take the form or enter into a product which he manufactures to sell, and which has to face competition. The competition proceeds from both large and small establishments. The larger establishments will possess foundries of their own, and obviously will have some method of grading the prices of their castings according to cost. The all-round price per cwt. may be the same with all the competitors, but the larger establishments in all probability manufacture other classes of products, and therefore find it necessary to obtain detailed costs.

The customer who buys at an all-round price naturally bases his material costs on this figure. He knows as well as the foundryman that some castings cost far more and others much less both as regards variety and size, but he has no cost records to work on, and therefore does not take the risk of grading.

High Cost Work at Average Price.

The result is, assuming his manufacturing conditions to be equal to those of his competitors, that the customer will obtain a class of work, the castings for which cost a high rate to mould, as he has based the material price of his product on the all-round price he pays. The competitor with a foundry of his own, and who grades his prices in accordance with cost, will include approximately correct material costs in arriving at his selling prices. These selling prices will, in some cases, be higher, and in others lower than the customer, according to the price-grade of castings entering into the product, and it can therefore be easily seen what class of work the customer is going to obtain. It will be work for which his price is favourable, which means where the foundry is concerned, work which has a high moulding cost. The other kind of work, "good heavy plain stuff," as the foundryman would say, never comes the way of the customer, for it enters into his selling price at the all-round figure he pays the founder, and not at the figure it actually costs, which is lower. All that class of work which would be very acceptable goes to the competitor who grades according to cost.

Such a position does not affect the customer very much.

He continues to receive orders of a certain kind and is making his customary profit. But the castings he is calling for from the foundry will be of the higher-price grade, and he will be obtaining them at the all-round price fixed at an earlier period, which of course means that the foundry is losing money on the business, and very probably will continue to do so for quite a long period. For when an agreed all-round price is once arranged, there does not appear to be any reason for alteration excepting in accordance with the fluctuation in costs of raw material and labour.

Where the foundry is a small one, and a customer of this nature taking a large percentage of the output, the financial condition of affairs will rapidly become worse, and a thorough investigation will find that the castings being made are not of the variety and weight which was expected when the fixed price per cwt. was agreed upon.

Where the foundry is a comparatively large one, and the customer taking only a small percentage of the output, the financial deterioration will be yet as sure, but more gradual, and will continue until sufficiently alarming to necessitate a thorough investigation, with the same result as stated above.

All-Round Price Fundamentally Wrong.

When the all-round price is agreed upon, the customer, in all good faith, fully expects to purchase all the varieties upon which the price is based, but this all-round price, being fundamentally wrong, defeats such expectation, particularly so during lean times when competition is keen.

Foundries, like other sections of the engineering industry, have during recent years more fully realised the great variation possible in the cost of various products, and the absolute necessity for methods of cost finding for fixing selling prices, castings being graded on a broad basis of the relation of the time occupied in moulding to the actual weight of the casting.

All-round prices to customers with a variety of requirements which enter into or form varied saleable products, is not a paying proposition for the founder. If at all possible, he should grade his selling prices according to costs, and if he considers this impracticable, should take particular care to see that the varieties and sizes of castings continually demanded are as expected at the time the agreed all-round price was made.

Contracts Open.

Dublin, October 23.—Supply of switches, for the Great Northern Railway (Ireland) Company. Mr. J. B. Stephens, secretary, Amiens Street Station, Dublin.

Edinburgh, October 20.—Supply of general stores required in the Gas Department for six months, from November 16, 1922, for the Town Council. Mr. H. H. Gracie, engineer and manager, 15, Calton Hill, Edinburgh.

Melbourne, January 15-31.—Supply, delivery, etc., of the following for the Morwell power scheme, for the State Electricity Commission of Victoria. Specification No. 308.—Back pressure steam turbine, including one 1,500-kw. turbo-alternator with exhaust valves, exhaust pressure regulator, etc. No. 317.—Water-tube boilers and accessories, including Section 1—Four boilers 4,500 sq. ft. h.s., step grates, dampers, mountings, etc. 2.—Structural steelwork for boiler-house, bunkers and turbine-house, including floor framing, stairs, etc. 3.—Turbine-driven feed pumps, make-up pumps, collector drums, tanks, meters, etc. 4.—Complete system of piping, valves, etc., for all plant. Agent-General for Victoria, Melbourne Place, Strand, London, W.C.2. (Fee, £2 2s., returnable.)

Newcastle-upon-Tyne, October 28.—For the construction and delivery of one non-propelled centre ladder barge-loading bucket dredger, four single-screw steel steam hopper barges, each with a hopper capacity of 800 tons, for the Tyne Improvement Commissioners. Mr. J. MacDonald Manson, general manager and secretary, Bewick Street, Newcastle-upon-Tyne. (Fee, £5 5s., returnable.)

Cerium as a Steel Alloy.—The study of cerium as an alloying element in steel, conducted at the Ithaca, N.Y., station of the U.S. Bureau of Mines, in co-operation with the Welsbach Company, has been finished. The attempt to utilise the cerium group of metals, made from by-products of the gas-mantle industry, in alloys other than the pyrophoric alloys, gave only negative results. In aluminium alloys the cerium group of metals had no useful effect either as alloy materials or as scavengers. In steel the desulphurisation effected by the cerium metals was accompanied by the retention in the steel of inclusions due to the cerium metals. The harmful effect of the inclusions over-balanced any good effect due to desulphurisation or to the presence of cerium metals as alloying elements. Either plain carbon steel, or various alloy steels to which cerium was added, were not improved; usually, especially when heat-treated, they were decidedly poorer than similar steels without cerium. Collected data showed cerium to have no marked effect as a true alloying element in steel, and to be harmful rather than helpful when used as a scavenger. The conclusion drawn was that, under any condition tried, the cerium group of metals was not useful either in steel or in aluminium, and such data as were available indicated that it would not be useful in other non-ferrous alloys.

The Nitrogenisation of Iron and Steel by Sodium Nitrate.*

By L. E. Benson, B.Sc. (Manchester University).

During some experimental work specimens of Armco iron and steels of varying composition were annealed in a salt-bath at a temperature of 500 deg. C. for varying lengths of time, having been previously normalised from 950 deg. C. Subsequent microscopical examination showed that most of the specimens so treated had developed a structure within the ferrite grains similar to that generally associated with the presence of nitrogen.

Although the specimens whilst in the salt-bath stood on a porcelain plate, their carburisation by diffusion of carbon from the cast-iron container, or from carbonaceous impurity in the salt, appeared to afford a possible explanation of the structure, as at that temperature (500 deg. C.) any carbide formed would precipitate along the cleavage planes and crystal boundaries. In order to explore this possibility, a specimen of the normalised Armco iron was annealed for 2½ hours at the same temperature in a bath of recrystallised sodium nitrate contained in a porcelain crucible. As a result of this treatment the iron was found to have developed the nitride structure to an average depth of 0.2 mm. from the surface.

A sample of Armco iron before annealing was found to contain less than 0.002 per cent. nitrogen. A specimen annealed for ten hours was observed under the microscope to exhibit the nitride structure to an average depth of 0.4 mm. Approximately 1.5 mm. was filed off all the faces of this specimen and the filings collected. A further 1 mm. was then filed off. The nitrogen content of the three samples was found to be as follows:—Outer layer, 0.036 per cent. nitrogen; intermediate layer, 0.004 per cent. nitrogen; core, 0.002 per cent. nitrogen. From these determinations it would appear that the specimens in question had become nitrogenised through being annealed at a temperature of 500 deg. C. in a salt-bath containing sodium nitrate.

As sodium nitrate is frequently the chief constituent of salt-baths for low-temperature heat treatment, it was thought advisable to investigate how far nitrogenisation was likely to affect iron and steels under varying conditions. The influence of time on the rate of penetration of nitrogen in Armco iron has been investigated up to eighty hours, and in various steels up to twenty hours. In general, the penetration was observed to be very uniform, and only in a very few cases was any difficulty experienced in arriving at a fair estimate of the average depth. The results of the penetration measurements will be found in Table I. The rate of penetration of nitrogen in steel in general appears to be considerably slower than in pure iron. It is seriously influenced by the presence of carbon, the rate being lowered as the carbon content rises.

Table I.—*Penetration of Nitrogen in Millimetres.*

Time of annealing.	A.	B.	C.	D.	E.	F.
Normalised	0.00	0.00	0.00	0.00	0.00	0.00
1 hour ..	0.15	0.00	0.05	0.00	0.00	0.00
5 hours ..	0.30	0.20	0.20	0.15	0.15	very slight
10 ,, ..	0.40	0.30	0.25	0.20	0.20	
20 ,, ..	0.70	0.40	0.30	0.20	0.20	
80 ,, ..	2.00	—	—	—	—	

A=Armco iron (guaranteed purity 99.84 per cent.).
B=Pure carbon.
C and D=Crucible steels.
E=Open-hearth steel.
F=Acid-Bessemer steel.

That the presence of pearlitic areas in the ferrite should impede the diffusion of nitride seems only natural, but the retardation produced by only 0.16 per cent. carbon as compared with that produced by 0.37 and 0.58 per cent. carbon seems sufficiently great to suggest that possibly influences other than merely the presence of pearlitic areas have contributed, and a greater solubility of carbide in alpha iron than has generally been supposed to exist might be expected to affect the rate of penetration thus.

Manganese would appear to exert a more profound influence on the rate of penetration than does carbon. This is in accordance with Tschischewski's observations on the nitrogenisation of iron manganese alloys.

The curve for steel containing 0.4 per cent. carbon and 0.54 per cent. manganese is identical with that for pure 0.6 per cent. carbon steel, but in the case of the acid-Bessemer steel containing 0.89 per cent. manganese the penetration was very slight indeed. Even after twenty hours' annealing the nitride structure was only observable in the outermost layers.

Tschischewski has found that above 450 deg. C. nitride of iron is unstable, and in this connection it is of interest that a piece of Armco iron 0.5 cm. thick, nitrogenised to such an extent that the characteristic needles could be observed almost to the centre of the mass, after heating in an open muffle for 90 minutes at approximately 700 deg. C., showed no signs at all of nitride structure, and on analysis the nitrogen content was found to be only 0.0025 per cent.

* Abstract from a paper read before the Iron and Steel Institute at the autumn meeting at York.

Research for Metals Industry.

An interesting pamphlet, "Research Work in Progress," has just been issued by the British Non-Ferrous Metals Research Association of 71, Temple Row, Birmingham. The investigations in hand cover many important problems of the copper, brass, aluminium, nickel and lead industries, as well as subjects of importance to all users of such metals. The support given to this Association by the leading firms seems to be most encouraging, but the field covered is very wide, and many of these researches such as those on the improvement of brass, on metal polishing, and on soldering should attract the attention and support of many other sections of industry. Of particular interest to foundrymen is a research which is being conducted on the surface and internal soundness of ingots, by Dr. H. Moore and Mr. R. Genders, B.Met., at the Woolwich Research Department. The user is apt at first sight to overlook the fact that he is even more interested in the improvement of quality of his raw material than the manufacturer of the metal. In the case of failure, however, it is the user who always bears the greater loss, since he sacrifices all the time and workmanship which has been expended on the article being manufactured.

The Bureau of Information of the Association also seems to be doing excellent service in distributing to members reports of the results of the experimental researches and acting as a live intelligence service collecting and distributing information likely to be of service to the industry from the far corners of the world.

Finally some indication is given of the further work which the Council hope to take up when additional financial support is forthcoming, which includes problems of importance to the electrical industries, to die casters and to the tinplate trade.

Waste in the Metal Industry.—Mr. A. J. Smout, the newly-elected president of the Birmingham Metallurgical Society, in the course of a presidential address devoted to the subject of "Waste and Inefficiency in the Metal Industry," said that a great deal of waste was caused by insufficient training, the industry having suffered from the lack of individual attention formerly given to youth and apprentices. Probably the greatest need of the metal industry was first-class technically-trained men to occupy the various positions of plant control coming between the directorate and manager and the manual worker. The Engineering Society's Committee of America found that in 15 representative plants 80 per cent. of the responsibility for waste rested with the managers and executives in control of the plant. One of the best methods of discovering waste was to adopt a modern cost system. Losses in ore dressing and concentration prior to smelting were often startling, and while the use of flotation processes had effected saving, there was still much to be done. On the question of fuel waste the speaker justified the emission of a certain amount of black smoke from chimneys, and considered that this form of waste had been greatly exaggerated. There was great scope, however, for the use of briquettes, which were very commonly employed in Germany, thereby saving coal which otherwise would be unfit for use. An enormous quantity of fuel could be saved by the collection of pit waste from the picking belts and gravity washers used at the collieries.

Trade Talk.

BAMLETT'S AGRICULTURAL ENGINEERING WORKS, Thirsk, restarted last week.

CLYDE & COMPANY, LIMITED, merchants and engineers, have removed to 61, Fore Street, London, E.C.2.

THE CHEMICAL AND METALLURGICAL CORPORATION, LIMITED, have purchased a site in West Ham for the erection of works.

IT IS STATED that Sir William B. Peat has been appointed receiver and manager on behalf of the debenture holders of Sheffield Steel Products, Limited.

BROOK, HIRST AND COMPANY, LIMITED, Northgate Electrical Works, Chester, have appointed T. Hood and Company, Limited, 7, St. Stephen's Avenue, Bristol, as their agents in the West of England.

THE WORKS of the Welsh Metals Extraction Company, Limited, are now to be sold by auction, as it has been found impossible to make arrangements to pay off the bank.

THE ASIATIC STEAM NAVIGATION COMPANY have placed orders with Charles Connell & Company, Limited, Scotstown, for two steamers of 8,500 tons dead weight each.

JOHN BLAIR & COMPANY, 80, Coleman Street, E.C., have been appointed sole London agents for the Dorrator Iron Company, Limited, Camelon, Falkirk, for the sale of rain water pipes and connections.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, have taken the order for the electrical equipment for the rolling stock for the new Piccadilly line. The value of the order is approximately £160,000.

THE IMPORTANCE of eliminating waste and inefficiency in the metal industries was the subject brought before the members of the Birmingham Metallurgical Society by Mr. A. J. G. Smout on his inauguration as president on October 4.

MR. J. E. FLETCHER delivered a lecture on "Working Slags in Ferrous Processes," before the members of the Birmingham Metallurgical Society at the Chamber of Commerce Buildings, New Street, Birmingham, on Wednesday.

W. CANNING & COMPANY, LIMITED, Great Hampton Street, Birmingham, have established a warehouse at 7 and 9, Sycamore Street, Sheffield, where stocks of machinery and equipment for electro-plating, polishing, lacquering, and bronzing will be carried.

Mr. W. R. Richardson, of Sir W. G. Armstrong, Whitworth & Company, Limited, recently read a paper on "Steel" before the Newcastle and District Association of Foremen Engineers and Draughtsmen. Mr. J. G. Brewster presided.

MR. D. BROSTROM, shipowner, of Gothenburg, has placed an order with the Deutsche Werft, of Hamburg, for the construction of two Diesel-engined vessels having a cargo-carrying capacity of 20,600 tons each. The vessels are for the transport of ore from Chile to New York for the Bethlehem Steel Company.

THE WORKS COMMITTEE of the Mersey Docks and Harbour Board has recommended acceptance of the offer of Cammell Laird & Company, Limited, of Birkenhead, to construct two self-propelling steam hopper barges, each having a carrying capacity of 1,000 tons, and 205 ft. in length, with a loaded draught of 14 ft. and a speed of 11 knots.

JOHN BEDFORD & SONS, LIMITED, Lion Works, Sheffield, announce the retirement of their London agent, Mr. T. E. Dickinson. In future the London agency will be controlled by C. Phillips, Jones & Company, at 6, Lloyd's Avenue, E.C.3, under the supervision of Mr. John Bedford, a director of the company.

THE ADJOURNED CONFERENCE of the engineering and shipbuilding employers and employed was held in Edinburgh last week for the purpose of receiving the report of the situation as revealed by the ballot. The figures were as follow:—For acceptance of employers' proposals, 7,148; for resisting by a strike, 24,267; for further negotiation, 57,824.

THE ASCERTAINMENT for September shows that the selling price of West Coast hematite mixed numbers was £4 9s. 5d. per ton, a reduction of 1s. 10d. per ton compared with the previous month, and of 16s. 5d. per ton compared with the price in January of this year. As the sliding scale is in abeyance pending the completion of the negotiations between the Ironmasters' Association and the Blastfurnacemen's Union, the percentage on the base wage cannot be stated.

THE ASCERTAINMENT issued by the Cleveland Ironmasters' Association certifies that the average net selling price of No. 3 Cleveland pig-iron for the past quarter was 85s. 7.16d. per ton, a reduction of 2s. 4.48d. per ton, as compared with the price for the previous quarter. Under the sliding scale arrangement there will be a reduction in blast-furnacemen's wages of 2.25 per cent., which will bring the wages from 26.25 per cent. to 24 per cent. above the standard. The reduction takes effect from October 1.

AN AWARD has been issued by the Industrial Court in regard to foundry labourers at Dowlais, giving certain base rates to the workers concerned in lieu of those at present in force. The parties to the case were the Workers' Union and Guest, Keen & Nettlefolds, Limited. This decision is supplementary to Decision 736, which dealt with a claim by the Union to the reinstatement of a quarter turn per shift, previously paid at the ingot mould foundry, Dowlais Works. In that decision the Court found that the payment of the quarter turn should not have been discontinued without notification, and they reinstated the quarter turn for a limited period in order to give the parties opportunity of discussing whether, on the merits of the case, the men concerned were entitled, by reason of the character of their work, to some payment over and above that of the ordinary labourers. The parties were directed to take this matter into consideration, and to determine the amount of the difference, if any, of the two rates in the light of the practice of other works employing a similar class of men. The parties were unable to agree, and the matter reverted to the Court, who accordingly sat to hear evidence on September 28. The further evidence submitted satisfied the Court that in so far as the extra payment rested upon considerations of output, the reason for its payment had disappeared. They were also satisfied, however, that the extra payment did not rest solely upon this ground, but that other circumstances were taken into account. It was right, therefore, that part of the extra payment should now disappear and that part should remain. As regards the part that should continue to be payable, the Court were of the view that they should be guided by the rates paid to men doing similar work at the only other ingot-mould foundry in the district. They accordingly decided that in lieu of the present base rates there shall be paid base rates as follows:—Cupola-man, 5s. 7d.; assistant, 4s. 11d.; ladleman, 4s. 11d.; labourer—tempering sand, 4s. 11d.; chipper, 4s. 11d.; labourers, 4s. 10d.

Catalogues Received.

Messrs. Pratchitt Brothers, engineers, Carlisle.—The section dealing with sand mills will be of interest to foundrymen.

Messrs. Sefco, Limited, Gipping Works, Stowmarket.—This little book outlines the advantages of Sefco—a new iron cement—as a filling for blowholes, cracks, and for smoothing rough places on castings.

Reversible Expansion of Silica.—At the recent Birmingham meeting of the Refractory Materials Section of the Ceramic Society, Mr. H. J. Houldsworth and Professor J. W. Cobb replied to more criticism by Dr. Fenner on the results set forth in their Paper on "The Reversible Thermal Expansion of Silica," read by them before the Section at a previous meeting. Dr. Fenner, in his criticism, contended that the results obtained by Messrs. Houldsworth and Cobb, far from being contradictory of anything he had obtained, were really a repetition in all essential respects of his own results. The only difference was that the presence of a little soda seemed to have effected the transformation to cristobalite at a somewhat lower temperature. Emphasis was laid on two important points: (1) The transformations of silica were of a very sluggish character, and (2) an unstable form often took the next less unstable form before changing into the stable form. Circumstances might thus delay indefinitely the conversion into the stable form. In any case, on reheating the material for a few hours (at the given temperature) after addition of a little sodium tungstate, very definite evidence of the production of the stable form would ordinarily be obtained. In reply, Mr. Houldsworth and Prof. Cobb pointed out that the primary object of their work was the determination of data concerning the reversible thermal expansion of different silica products after varying heat treatments, for approximately the ranges of temperature, time, composition, etc., occurring in practice. They looked on Dr. Fenner's original Paper on "The Stability Relations of Silica Materials" as an extremely valuable contribution to the study of silica inversions, but in most of his experiments he heated silica with large amounts of sodium tungstate, and for their purpose it was necessary that silica material should be examined without that flux.

Company News.

Maximon, Limited.—Capital £20,000 in £1 shares. Engineers.

Anderston Foundry, Limited.—Interim dividend, 3s. per share, less tax.

Mountstuart Dry Docks & Shearmans, Limited.—Balance-sheet deferred.

Bussey & Sabberton Brothers, Limited.—Capital £15,000 in £1 shares. Engineers.

Richardsons, Westgarth & Company, Limited.—Interim preference dividend, 3 per cent.

Stanton Ironworks Company, Limited.—Half-year's preference dividend, 6 per cent. per annum.

Clayton & Shuttleworth, Limited.—No interim dividend on 5 per cent. cumulative preference shares.

Yates & Thom, Limited.—Dividend, 7½ per cent. actual for year; reserve, £10,000; carried forward, £15,007.

C. A. Daniel, Limited, Aston Brook Street, Birmingham.—Capital £500 in £1 shares. Pattern makers, founders, etc.

Furness, Withy & Company, Limited.—Ordinary dividend, 5 per cent. per annum for half-year; preference dividend, 5 per cent. for half-year.

Thomas Smith's Stamping Works, Limited.—Profit, £17,050; brought forward, £13,085; dividend, 7½ per cent., less tax, for year; carry forward, £16,697.

Tinsley Rolling Mills Company, Limited.—Accounts show loss £8,658; no dividend on ordinary; brought forward, £12,098; credit at profit and loss, £3,437.

R. W. Barker & Company, Limited, Oakwood Parade, 450, Roundhay Road, Leeds.—Capital £2,000. Engineers, etc. Directors: H. A. H. Walker, S. Verity, and R. W. Barker.

Delta Steel Company (Sheffield), Limited.—Capital £3,000 in £1 shares. Permanent directors: H. M. Hurst (managing director), G. W. Hurst, and C. E. Moore. Secretary: W. Neal.

L. P. M. Syndicate, Limited, 82, Victoria Street, Westminster, London, S.W.—Capital £15,000 in 12,000 10 per cent. cumulative preference shares of £1 and £60,000 deferred shares of 1s. Engineers.

John Fowler (Don Foundry), Limited, Don Foundry, Attercliffe, Sheffield.—Capital £22,000, in £1 shares, to acquire the business of an ironfounder carried on by J. Fowler. Directors: J. Fowler (permanent director and chairman), C. C. Marshall, J. K. Smith and F. Betts. Secretary: F. Laister.

Gazette.

Palmer Foundry Company, Limited, London, S.W.—Mr. G. W. Roberts, 2, Guildhall Chambers, 31/4, Basinghall Street, E.C., I.A., was appointed receiver, September 21.

Messrs. T. Young and G. H. Burgess, consulting and inspecting engineers, 39a, New Street, Birmingham, trading under the style of Young & Burgess, have dissolved partnership.

Messrs. B. N. Taylor and F. C. Hayter, engineers' manufacturers, Park Street, near St. Albans, and Edgware, trading under the style of Taylor & Hayter, have dissolved partnership.

Stirlingshire Iron and Stove Company, Limited.—It has been resolved: That the company be wound up voluntarily. Mr. R. Macfarlan, 149, West George Street, Glasgow, C.A., was appointed liquidator.

Messrs. S. S. Jackson and H. J. Jackson, engineers and wheelwrights, Great Baddow, trading under the style of S. & H. Jackson, have dissolved partnership. Mr. H. J. Jackson will continue the business in his own name.

Messrs. W. R. Barrett, D. George, and D. E. Morris, metal merchants, etc., Swansea and Rouen, have dissolved partnership. The business will be continued under the same name by Messrs. W. R. Barrett and D. George.

Messrs. A. C. Powell and W. Crossley, engineers, Carr Mills, Meanwood Road, Leeds, trading under the style of Powell & Crossley, have dissolved partnership. Mr. A. C. Powell will carry on the business on his own account.

Bevan & Company (Iron and Brass Founders), Limited, Neath.—It has been resolved and confirmed: That in order to carry into effect the agreement, dated August 18, 1922, between T. J. Bevan, on behalf of Bevan & Company (Iron and Brass Founders), Limited, and Wm. E. Cope, Glentworth, Sketty, Swansea, for sale of the undertaking of this company to said W. E. Cope, in accordance with resolution passed by a directors' meeting of this company on November 3, 1921, this company be wound up voluntarily. Mr. F. Jennings, 14, Green Street, Neath, I.A., has been appointed liquidator.

Personal.

The late Mr. Charles Keay, engineer, of Cromwell House, Oakfield Road, Selly Park, left gross estate of the value of £53,493, with net personalty £45,643.

Mr. H. Douglas, assistant manager of John Tullis & Son, Limited, St. Ann's Works, Bridgeton, Glasgow, has been the recipient of presentations from the directors, officials, and employés of the company to mark his completion of fifty years' service.

Mr. W. B. M. Jackson, of the Sheepbridge Coal and Iron Company, Limited, has, owing to pressure of business, resigned his membership of the Chesterfield and District Employment Committee. The company have been invited to nominate another representative.

Mr. J. Jenkins, chief engineer to the Glasgow Iron & Steel Company, Limited, Wishaw, who has been appointed to the post of chief engineer at Messrs. Guest, Keen & Nettlefold's Dowlais Works, has been the recipient of a presentation from the staff and employés at the Wishaw works.

Mr. J. P. Anderson has been appointed assistant engineering manager to Cammell, Laird & Company, Limited, Birkenhead, taking the position left vacant when Mr. W. H. McMenemey was made engineering manager some months ago. Mr. Anderson was formerly chief draughtsman at the engine works of Workman, Clark & Company, Limited, Belfast.

Mr. Leonard Ropner, of the Ropner Shipbuilding and Repairing Company (Stockton), Limited, has been elected president of the Shipbuilding Employers' Federation in place of Mr. James Lithgow, of Lithgow, Limited, Port Glasgow, who retires. Mr. Grant Bartley, Dundee, becomes senior vice-president, and Mr. John Barr, managing director of Vickers, Limited, Barrow, has been elected junior vice-president.

Deaths.

Mr. Isaac Johnston, secretary of Messrs. Harland & Wolff's Govan Works, died suddenly at Banff, Scotland, last week.

Mr. P. St. John Dawnay, of Penylan Road, Cardiff, the youngest and only surviving son of the late Sir Archibald Dawnay, of Archibald D. Dawnay and Sons, Limited, constructional engineers, London and Cardiff, died recently at the age of forty-eight.

Mr. H. Huse Campbell, superintendent and general manager of the Pennsylvania Steel Company, at Steelton, Pa., U.S.A., has died at the age of 63. Mr. Campbell will be remembered as the author of the well-known work, "The Manufacture and Properties of Steel."

Mr. Samuel Withers, for many years a prominent figure in the public and commercial life of West Bromwich and district, died recently. Mr. Withers, who was in his 82nd year, founded the firm of Samuel Withers & Company, Limited, which has grown to be one of the largest safe manufacturing concerns in the country.

Mr. Marmaduke Wardlow, who died on October 5, was one of the most prominent business men in Sheffield, and last year filled the position of Master Cutler. Mr. Wardlow had been in failing health for some time, and there is little doubt his devotion to business and to the high office which he held contributed to the final breakdown. Mr. Wardlow was a prominent figure in the steel world of Sheffield, being the proprietor of the firm of S. & C. Wardlow, of Portobello Steel Works, Sheffield, and Congress Works, Oughtibridge. He was the only son of Mr. Charles Wardlow, Senr., who, with his brother Samuel, founded the firm in 1883. Mr. Marmaduke Wardlow, when 21 years of age, entered the firm as partner with his cousin, Mr. Charles Wardlow, and when the latter retired from the firm in 1892, Mr. Marmaduke Wardlow became the sole proprietor.

More Foundry Papers.

In common with most other engineering societies, the Manchester Association of Engineers are interesting themselves in foundry practice. This session they are having two papers on the subject. The first is on November 24, when Mr. W. H. Cook deals with "Plate Moulding," and the second on March 9 when Mr. E. Adamson lectures on "Carbon in Cast Iron."

Mr. David McLain, who sailed last Saturday on the *Tuscania* for New York, was offered a farewell dinner by Prof. Campion and Messrs. Matt. Riddell, J. Cameron, Donald King, James Shanks, G. A. Ure, J. T. Moore, and others. He hopes to revisit Great Britain in the spring.

IRON AND STEEL MARKETS.

Pig-iron.

Although production of pig-iron continues on its previously restricted scale, the tone of markets remains consistently firm, and with stocks in makers' yards almost depleted, values are distinctly stronger. The chief factor in the position is, of course, the American demand, which, although labour troubles on that side are fast disappearing, is due to the prolonged suspension of pig production during the strike period, and a consequent scarcity of raw material for current manufacturing requirements. These conditions have naturally favoured home producers, this month's shipments of pig-iron to Atlantic ports for the first ten days amounting to nearly 15,000 tons from Tees-side alone, while heavy tonnages have also been despatched from the Clyde. In the Midlands very little advantage has accrued to pig-iron producers from the increased demand for export, and here, also, makers are heavily handicapped by the advance in coke prices, which unquestionably retards any substantial revival of home consumption. The finished iron manufacturers are, however, taking a little more tonnage than of late, but unfortunately the foundry branch still remains quiet, not having yet fully recovered from the effects of the engineering stoppage. There has been no material change in the Cleveland market, wherein, though the volume of business is somewhat reduced, American demand is still the outstanding feature. Signs of improvement are also perceptible in the home trade, subject, however, to some competition from Midland and Continental iron especially affecting buying on Scottish account. Tees-side makers have also to complain of the steady increase in fuel costs, furnace coke having advanced by something like 4s. 6d. per ton, which means about 6s. on every ton of pig-iron. Consequently there can be little hope of any reduction in pig-iron prices so long as coke continues so dear; on the contrary, the tendency is much more likely to be in the other direction. Up to the present Cleveland makers have made no move, but quotations are all very firmly held. Stocks of the better qualities, too, are very scarce. Still, the position is a very uncertain one, for as soon as American buyers are off the market the effect of the current high prices will be keenly felt. The following are current quotations:—No. 1 and silicious, 97s. 6d.; No. 3 G.M.B., 92s. 6d.; No. 4 foundry, 90s.; No. 4 forge, 85s. per ton.

In contrast with what was expected, the market for East Coast hematite has made a striking recovery, the relative cheapness of this material as compared with foundry iron having attracted the attention of American buyers, with the result that substantial tonnages have been disposed of. Home consumers are also ordering more freely, and in consequence the heavy stocks held a short time back have very nearly disappeared. As a result quotations have sharply advanced, and at last week's Tees-side market 91s. was a minimum figure for mixed numbers, most makers, in fact, standing out for 92s. to 92s. 6d. per ton. The No. 1 quality is at a premium of 6d. to 1s. per ton. Only a month ago it was possible to buy mixed numbers at as low as 88s. per ton, and makers will still have a lot of cheap iron to get off their books. The better conditions in the steel trade and in shipbuilding point to a maintenance of the recent improvement, while the rise in coke prices will effectually prevent any early return to the recent very low levels. West Coast hematite prices are unchanged, Bessemer mixed numbers being quoted at 100s. per ton delivered at Glasgow and Sheffield, and for export at 102s. 6d. to 105s. per ton.

Finished Iron.

As usual, there was a large attendance at the quarterly meeting last week, visitors being present from all the principal centres of the industry. In every department demand was much below what is required to give business even a semblance of activity and prosperity. In view of the present state of the markets buyers were not prepared to enter into forward contracts of any size; indeed, their purchases were mainly of the hand-to-mouth order. The limited volume of business negotiated was chiefly restricted to the bar-iron section, in which marked qualities alone continue steady and firm at the previous quotation, £13 10s. Good-quality crown bars can now be bought below £11, while nut and bolt iron, under the pressure of foreign competition, has now fallen to £9 15s.; in addition to this the home demand is rather quiet. Gas strip does not make any headway against steel strip, which can be bought for much less, and the makers have had a meeting with the object of avoiding competition, the £11 price having been cut recently.

Steel.

Some degree of returning confidence is expressed of late in the prospects of the steel trade by a resumption of partial activity in employment, the returns for Sheffield and district showing a gradual absorption of workers, while a rather better volume of inquiries on export account is another feature indicating improvement in business. In the latter connection some fair orders having been booked from the Colonies and Russia. In the market for semi-products some scarcity of basic billets is reported, but acid qualities are fairly plentiful. For hard basic billets the quotation is £8 5s., for medium £8, and for soft £7 5s., delivered Sheffield. For Bessemer acid billets the figure stands at £12 10s., and for Siemens acid £10. Quite a proportion of the business in basic billets is for export. The Welsh makers have reduced their price for sheet and tinplate bars to £7. Steel manufacturers state that the call for special steels is decidedly better, while the improved demand for stainless is such that several additional electric furnaces have been put into operation. For steel strip there is a remarkably good demand just now, this applying to both hot and cold rolled, with spring steel another active item. The ferro-alloys market also evidences movements favourable to a further expansion of the steel trade, ferro-silicon, for example, showing a better demand, with similar indications applying in the case of high-carbon grade ferro-chromes, 4/6 per cent. having been called for in several directions, both for home consumption as well as for export. This in itself may be taken as a sign of the times, and suggests that the heavy trades and large industrial concerns are getting more substantial orders for their productions. The tinplate market of late has shown a more active tendency, and a more confident tone is now apparent. South America is still buying, and several lines have been fixed up with Scandinavia. There is also a slight improvement in the Continental demand. For the standard sizes, current quotations for coke tins now rule:—IC 14 by 20, 112 sheets, 108 lbs., 19s. 3d. and up per box; IC 28 by 20, 112 sheets, 216 lbs., 38s. 6d. and up per box; with usual options of light and crosses, net cash, f.o.b. Wales.

Scrap.

Generally, it is reported, there is at last some signs of movement in the scrap metal markets, though for the present mainly affecting heavy steel qualities, for which the demand shows distinct revival. On the other hand, inquiries on behalf of iron-founders continue in limited volume, a qualification applying equally to wrought scrap. At Middlesbrough heavy steel scrap is in steady demand, with the price firm at 65s. per ton. There is a scarcity of heavy steel turnings, and these are readily absorbed at as much as 53s. 6d. per ton, with cast-iron borings 52s. 6d. There is a fair demand for heavy cast-iron machinery scrap in handy pieces at 75s. to 77s. 6d., ordinary descriptions making 70s. to 72s. 6d. Heavy wrought iron is very dull, with prices quite nominal at 55s. to 57s. 6d. for bushelling.

Metals.

Copper.—Values on the market for standard copper during the past week reflected the fluctuations of the American exchange, the statistical situation of the metal being practically disregarded. Consumptive demand on this side continues below average, and with the exception of fairly good sales in France, the same may be said with regard to the Continent. Firm reports continue to arrive from America, and in some quarters a higher level of values is spoken of in that country. Considerable sales are reported to have been made on export account, while the domestic demand has improved. Current quotations:—*Cash*: Wednesday, £62 12s. 6d.; Thursday, £62 2s. 6d.; Friday, £62 12s. 6d.; Monday, £62 12s. 6d.; Tuesday, £62 10s. *Three months*: Wednesday, £63 5s.; Thursday, £62 15s.; Friday, £63 5s.; Monday, £63 5s.; Tuesday, £63 2s. 6d

Tin.—Business in the standard tin market on the whole continues fairly active, while the tendency of values during the past week has been in an upward direction. Political events in the Near East are, however, responsible for the occasional fluctuations recorded, consistent buying by large interests having caused "bears" to cover freely, and although the demand from home consumers leaves a good deal of room for improvement, America has at times been a free buyer. Current quotations:—*Cash*: Wednesday, £165 17s. 6d.; Thursday, £166 5s.; Friday, £167 15s.; Monday, £168 17s. 6d.; Tuesday, £169 7s. 6d. *Three months*: Wednesday, £167 2s. 6d.; Thursday, £167 10s.; Friday, £168 12s. 6d.; Monday, £170; Tuesday, £170 10s.

Spelter.—The market for this metal maintains remarkable firmness, the high level of values recently reported being strongly held, due, it is suggested, to speculative buying. Supplies from the Continent continue only on a small scale, but the present level of price is bound ultimately to stimulate production, but meantime higher prices may quite easily be seen. Current quotations :—*Ordinary*: Wednesday, £32 15s.; Thursday, £32 17s. 6d.; Friday, £33 2s. 6d.; Monday, £33 17s. 6d.; Tuesday, £34 5s.

Lead.—The demand for soft foreign pig continues fairly active, and recent heavy arrivals have been easily absorbed. At present there is no prospect of any increased supplies coming along, while consumers are showing more disposition to secure their forward requirements. America is consuming large quantities, and prices there are maintained at a high level. Current quotations :—*Soft foreign (prompt)*: Wednesday, £25 5s.; Thursday, £25 5s.; Friday, £25 7s. 6d.; Monday, £25 11s. 3d.; Tuesday, £25 11s. 3d.

Forthcoming Events.

OCTOBER 20.

Society of Chemical Industry (South Wales Section):—Ordinary meeting at Cardiff. "Congealing Temperatures of Essential Oils," Paper by Prof. W. J. Jones, D.Sc.

OCTOBER 21.

Institution of British Foundrymen (Newcastle-on-Tyne Branch):—Visit to works of the North-Eastern Marine Engineering Company, Limited, Wallsend. Discussion on "The Problem of Grey Iron Castings." Paper by H. J. Young, F.I.C. (Branch President).

OCTOBER 24.

Institution of Automobile Engineers (Coventry Centre):—Ordinary general meeting at Coventry.

Sheffield Association of Metallurgists and Metallurgical Chemists:—Ordinary meeting at Sheffield. "Lubricants and Lubrication," Paper by B. W. Methley, F.I.C.

OCTOBER 25.

Institution of British Foundrymen (Coventry Branch):—Ordinary meeting at Coventry. "Notes on Iron and Steel and Brass Founding," Paper by Dr. P. Longmuir.

OCTOBER 26.

Institution of Mechanical Engineers (Midland Branch):—"Importance of Testing Materials for Manufacturing Purposes." Paper by P. J. Worsley.

Institution of Mechanical Engineers (North-Western Branch):—Annual dinner.

OCTOBER 27.

Institution of Mechanical Engineers:—Extra general meeting. Adjourned discussion on "The Use of the Turbo Compressor for Attaining the Greatest Speeds in Aviation." By Prof. Auguste Rateau.

OCTOBER 28.

Institution of British Foundrymen (Newcastle-on-Tyne Branch):—Ordinary meeting at Newcastle. "Notes on Iron and Steel and Brassfounding," Paper by Dr. P. Longmuir.

Staffordshire Iron and Steel Institute.—Short address by the President, Mr. J. Payton; address by the Vice-President, Mr. F. J. Cook, on his American experiences in connection with the iron and steel industries.

OCTOBER 31.

Junior Institution of Engineers (North-Eastern Section):—Informal meeting at Newcastle-on-Tyne.

NOVEMBER 2.

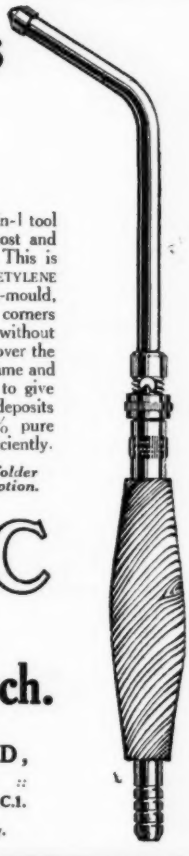
Finsbury Technical College, Leonard Street, City Road:—Streatfeild Memorial Lecture. "The Metallurgical Chemist." By Prof. Cecil H. Desch, D.Sc., Ph.D., F.I.C. 4 p.m.

For free sample and low prices write—

LAWSON, WALTON & CO. LTD.

2 St Nicholas Buildings, NEWCASTLE-on-TYNE

3 Useful Tools in One



HERE is a new and inexpensive 3-in-1 tool that will quickly save its first cost and thereafter give sheer profit. This is how you use the CARBIC ADJUSTABLE ACETYLENE TORCH. On a large and costly sand-mould, for example; examine deep awkward corners with the torch set to lighting position; without moving the torch move adjusting ring over the air ports to give a clear hot bunsen flame and "dry" the mould—then set the ring to give a smoky soot-laden flame which rapidly deposits an even layer of finely divided 100% pure carbon. A boy can use this torch efficiently.

Send a Post Card for Illustrated Folder and Price List giving the full description.

CARBIC

Adjustable Acetylene Torch.

Patentees and Sole Manufacturers—

CARBIC LIMITED,

:: :: *Specialists in Acetylene* :: ::

51, Holborn Viaduct, London, E.C.1.

Branches throughout the country.

For Wood, Metal or Plate

PATTERNS

(Large or small)

send to

FURMSTON & LAWLOR

Engineers' Pattern Makers,

BIRDS HILL, LETCHWORTH.

Telephone 185.

S. J. BURRELL PRIOR, LTD.,

Equitable House,

47-51, KING WILLIAM STREET, LONDON, E.C.

TIN PLATES,

BLACK PLATES,

ROUND & RECTANGULAR PLATES,

For Enamelling and Deep Stamping.

Telegrams: "PRIOR, LONDON."

WEEKLY PRICE CURRENT.

COPPER.

	£	s	d.
Standard cash	62	10	0
Three months	63	2	6
Electrolytic	71	0	0
Tough	65	10	0
Best selected	65	10	0
Sheets	96	0	0
India	84	0	0
Wire bars	71	0	0
Do. Nov.	71	0	0
Do. Dec.	71	0	0
Ingot bars	71	0	0
H.C. wire rods	76	0	0
Off. aver. cash, Sept. 63	3	4½	
Do. 3 mths., Sept. 63	12	5½	
Do. Settlement Sept. 63	2	11½	
Do. Electro, Sept. 71	3	2¼	
Do. B.S., Sept.	67	0	0
Aver. spot price, copper, Sept.	63	2	7½
Do. Electro, Sept. 71	8	1	
Solid drawn tubes		13½d.	
Brazed tubes		13½d.	
Wire		10½d.	
Yellow metal rods		6½d.	
Do. 4x4 Squares		8½d.	
Do. 4x3 Sheets		9½d	

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d
Rods, drawn	10½d.
Rods, extruded or rolled	6½d.
Sheets to 10 w.g.	10d.
Wire	9½d.
Rolled metal	9½d.

TIN.

	£	s	d
Standard cash	169	7	6
Three Months	170	10	0
English	169	0	0
Bars	171	0	0
Chinese	168	10	0
Straits	169	17	6
Australian	170	0	0
Eastern	172	0	0
Banca	169	10	0
Off. aver., cash, Sept.	160	2	8½
Do. 3 mths., Sept.	160	0	7½
Do. Sttlment. Sept.	160	2	3½
Aver. spot, Sept.	160	1	3¾

SPELTER.

	£	s	d
Ordinary	34	5	0
Remelted	31	12	6
Hard	25	0	0
Electro 99.9	38	0	0
English	34	0	0
India	26	5	0
Prime Western	33	17	6
Zinc dust	48	0	0
Zinc ashes	11	0	0
Off. aver., Sept.	31	8	8¾
Aver., spot, Sept.	31	14	10½

LEAD.

	£	s	d
Soft foreign ppt	25	11	3
English	26	15	0
Off. average, Sept.	23	16	3 5/8
Average spot, Sept.	24	2	9

ZINC SHEETS.

	£	s	d
Zinc sheets, English	39	10	0
Do. V.M. ex. whf.	40	0	0
Dutch	39	10	0
Rods	44	0	0
Boiler plates	37	10	0
Battery plates	38	0	0

ANTIMONY.

	£	s	d
English regulus	27	0	0
Special brands	33	10	0
Chinese	25	10	0
Crude	17	0	0

QUICKSILVER.

	£	s	d
Quicksilver	12	12	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s	d
Ferro-silicon—			
45/50%	11	5	0
75%	19	15	0
Ferro-vanadium— 35/40%	17/- lb. va.		
Ferro-molybdenum— 70/75%	8/6 lb. mo.		
Ferro-titanium— 23/25%, carbonless	1/1 lb.		
Ferro-phosphorus, 20/23%,	£25		
Ferro-tungsten— 80/85%, carbon free	1/5 lb.		
Tungsten metal powder— 98/99%	1/11 lb.		
Ferro-chrome— 4/6% car.	£23	5	
6/8% car.	£22	15	
8/10% car.	£22	10	
Ferro-chrome— Max. 2% car.	£55		
Max. 1% car.	£68		
Max. 0.70% car.	£75		
67/70%, carbonless	1/6½ lb.		
Nickel—99%, cubes or pellets	£140		
Cobalt metal—98/99%	12/- lb.		
Aluminium—98/99%	£95		
Metallic Chromium— 96/98%	4/9 lb.		
Ferro-manganese(net)— 76/80%, loose	£15		
76/80%, packed	£16		
76/80%, export	£14	10	
Metallic manganese— 94/96%, carbonless	2/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ½ in. 3d. lb.
Flats under 1 in. by ½ in. to ½ in. by ½ in., and all sizes over four times in width over thickness .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. 3d. lb.
Packing .. £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. 3d.
Turnings and swarf .. 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.
Heavy Steel	3	5	0
Bundled steel & shearings	2	17	0
Mixed iron & steel	2	15	0
Heavy cast iron	3	5	0
Good machinery for foundries	4	0	0

Cleveland—	£	s.	d
Heavy steel	3	5	0
Steel turnings	2	13	0
Cast-iron borings	2	12	6
Heavy forge	3	12	6
Bushelled scrap	2	16	3
Cast-iron scrap	3	11	3

Lancashire—	£	s.	d
Cast iron scrap	3	17	6
Heavy wrought	3	7	6
Steel turnings	2	2	6

London—	£	s.	d.
Copper (clean)	56	0	0
Brass (clean)	30	0	0
Lead (less usual draft)	21	0	0
Tea lead	19	0	0
Zinc	17	0	0
New aluminium cuttings	60	0	0
Braziery copper	46	0	0
Gun metal	40	0	0
Hollow pewter	125	0	0
Shaped black pewter	80	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	97/6
Foundry No. 3	92/6
Forge No. 4	85/-
Mottled	80/-
Hematite No. 1	91/9
Hematite M/Nos.	91/-
Midlands—	
Staffs. common	—
,, part-mine forge	—
,, ,, foundry	—
,, Cold blast	240/-
,, basic	—
Northants forge	70/- to 72/6
,, foundry No. 3	77/6 ,, 80/-
,, basic	80/-
Derbyshire forge	75/-
,, foundry No. 3	82/6
,, basic	80/-
Scotland—	
Foundry No. 1	105/-
,, No. 3	100/-
Hematite M/Nos.	107/6
Sheffield (d/d district)—	
Derby forge	82/6
,, foundry No. 3	86/6
,, basic	—
Lincs. forge	86/6
,, foundry No. 3	87/6
,, basic	86/6
E.C. hematite	102/-
W.C. hematite	102/6
All d/d in the district.	
Lancashire (d/d eq. Man.) —	
Derby forge	—
,, foundry No. 3	90/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	—
Summerlee foundry	116/6
Glengarnock foundry	118/6
Gartsherrie foundry	118/6
Monkland foundry	116/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£10 15 to 11	15	0
Tees to 3 united ins.	£11 to £12		
Nut and bolt	9	15	0
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	10	15	0
Bolts and nuts, ½ in. × 4 in.	18	10	0
Steel—			
Ship plates	£9 to 9	10	0
Boiler plates	12	10	0
Chequer plates	10	5	0
Angles	£8 12 6 to 9	0	0
Tee	£9 12 6 to 10	0	0
Channels	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in.	9	15	0
Rounds, under 3in. to ½in.	9	5	0
Flats, over 5in. wide and up	9	15	0
Flats 5in. to 1½in.	8	5	0

	£	s.	d
Rails, heavy	8	15	0
Fishplates	14	10	0
Hoops	11	10	0
Black sheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	5	0
Galv. fencing wire, 8 g. plain	16	0	0
Rivets, ½ in. dia	12	15	0
Billets, soft	7 0 0 to 7	2	6
Billets, hard	8	0	0
Sheet bars	6 17 6 to 7	7	6

PHOSPHOR BRONZE.

	Per lb basis
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6½ to 2/0½
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8½ to 2/2½
Ingots for spoons and forks	11d. to 1/5
Ingots rolled to spoon size	1/2 to 1/8
Wire round—	
3/0 to 10. G.	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	33.14
No. 2 foundry Valley	33.00
No. 2 foundry, Birm.	27.00
Basic	35.46
Bessemer	35.77
Malleable	35.46
Grey forge	34.27
Ferro-manganese 80 % delivered	75.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	40.00
O.-h. billets	49.00
O.-h. sheet bars	40.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.47
Steel bars	2.00
Tank plates	2.25
Beams, etc.	2.00
Skelp, grooved steel	2.00
Skelp, sheared steel	2.00
Steel hoops	2.90
Sheets, black, No. 28	3.50
Sheets, galv., No. 28	4.50
Sheets, blue an'l'd, 9&10	2.60
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv.	3.35
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	35/- to 37/6
,, furnace	26/- to 27/6
Durham & North. foundry	30/-
,, furnace	26/-
Other Districts, foundry	30/-
,, furnace	25/-

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

Rolled Ordinary—Assortment ..	£ 17 s. 10 d. 0 to
Nail Rods—Square, round and flats ..	18 0 0
Keg Steel nom.	£38 to £40
Faggot Steel nom.	£30 to £32
Blooms—Single welded ..	£10 to £11
Billets—Single and double welded	£13 to £14

Pig-Iron—Grey, white or mottled .. £7 to £7 10 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas ..	55%	Tube prices are now free.
Water ..	50%	
Steam ..	45%	

TINPLATES.

I.C.Cokes,	20×14, box	19/3
„	28×20, „	38/6
„	20×10, „	28/3
„	18¾×14, „	18/9
I.X.	„	43/9
I.X.X.	„	50/6
F.C.B.Y.	21×13⅝ „	36/6
C.V.B.G.	16¾×15, „	35/-
I.C.W.	20×14, „	17/-
„	28×20, „	33/6
„	20×10, „	22/9
„	18¾×14, „	17/6
Terneplates,	28×20, „	34/6

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Oct. 11	62	12	6	dec.	7/6
„ 12	62	2	6	„	10/-
„ 13	62	12	6	inc.	10/-
„ 16	62	12	6	No change	
„ 17	62	10	0	dec.	2/6

Electrolytic Copper.

Oct. 11	71	0	0	No change	
„ 12	70	10	0	dec.	10/-
„ 13	71	0	0	inc.	10/-
„ 16	71	0	0	No change	
„ 17	71	0	0	„	

Standard Tin (cash).

Oct. 11	165	17	6	inc.	15/-
„ 12	166	5	0	„	7/6
„ 13	167	12	6	„	27/6
„ 16	168	17	6	„	25/-
„ 17	169	7	6	„	10/-

Tin (English ingots)

Oct. 11	165	10	0	inc.	17/6
„ 12	165	15	0	inc.	5/-
„ 13	167	2	6	„	27/6
„ 16	168	7	6	„	25/-
„ 17	169	0	0	„	12/6

Zinc Sheets (English).

Oct. 11	39	0	0	inc.	20/-
„ 12	39	0	0	No change	
„ 13	39	0	0	„	
„ 16	39	0	0	„	
„ 17	39	10	0	inc.	10/-

Spelter (ordinary).

Oct. 11	32	15	0	dec.	5/-
„ 12	32	17	6	inc.	2/6
„ 13	33	2	6	„	5/-
„ 16	33	17	6	„	15/-
„ 17	34	5	0	„	7/6

Lead (English).

Oct. 11	26	10	0	No change	
„ 12	26	10	0	„	
„ 13	26	10	0	„	
„ 16	26	15	0	inc.	5/-
„ 17	26	15	0	No change	

There's something for You among these

Blacking, Coal Dust, Plumbago, Charcoal, Core Gum, Terra Flake, Gannister, Core Oils, Sea Sand, Moulding Sand, Iron Cement, Brushes, Bellows, Buckets, Chaplets, Core Ropes, Core Tapers, Ladles, Crucibles, Cupolas, Riddles, Sprigs, Spades, Carborundum Bricks and Wheels, Ferro-Aluminium, Blacking Bags, Foundry Plant, Etc., Etc., Etc.

F. L. HUNT & CO., 56, 58, 60, Chapel Street, Salford, Manchester.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT
5, MURZBAN ROAD, BOMBAY.
1, LALL BAZAR CALCUTTA.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
31, RAFFLES PLACE, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5 SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

IRON & STEEL SCRAP

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

MOULDER REQUIRES STEADY AND PROGRESSIVE JOB. Accustomed to complete control. Motor and General Engineer and Jobbing. Personally operating Cupola and other Furnaces, making oil-sand jacket cores, and supplying castings to analysis. Iron, Aluminium and Bronze. Good Technical and Practical: Mathematics, Mechanics, Chemistry, Physics, Metallurgy, Iron and Steel Manager and Mechanical Drawing. Good knowledge of costs, and could assist in Drawing Office, Pattern Shop or any department of Foundry. I.B.F. and B.C.I.R.A. Man. — Apply: F. A., c/o Ignition Laboratory, 57, Union Street, Oldham, Lancs.

FOUNDRY MANAGER or Assistant, age 38, experienced Steam and Motor Cylinders, Pumps, etc., Quantity Production, desires Engagement. Patterns, Moulding Equipment, Mixing by Analysis, Cupola Practice, extensive Experience of Oil Sand Cores, Core Jigging, modern Core- and Mould-drying Stoves. Knowledge costing and estimating. A.M.I.Brit.F.—Replies, "M.," Hill View, Pollards Hill West, Norbury, London, S.W.16.

FOUNDRY FOREMAN (31) desires progressive and responsible situation; technical and practical experience in up-to-date methods of production; Green and Dry Sand, Plate and Machine, Pattern Plates, Core Making, personally operated Cupola, mix to analysis; good organiser.—Box 272, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

HIGH-CLASS and Practical Foundryman wants Job as Foundry Manager, Foreman, or Assistant Foreman; age 30. Past four years foreman, then manager of large motor firm's foundries, doing big production in iron, aluminium and brasses. Undoubted ability and sound credentials.—Apply Box 276, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, FIRST-CLASS MACHINE CORE MAKER. State age, wages, experience of Machines, to Box 274, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED.—One Foundry Foreman for heavy marine work and one for light castings and cylinders in Great Britain; McLain Graduates preferred.—State age, experience and salary first letter to McLain's System (Inc.), 710, Goldsmith Building, Milwaukee, Wis.

AGENCIES.

ACTIVE AGENT, established in Belgium, well up in Metallurgical Trade, in constant touch with Rolling Mills of South Belgium and Luxembourg, wishes to act as Buying Agent on commission for large English Builders or Exporters. Best references. —Write to A. K., Eclair-Publicite, Charleroi, Belgium.

AUCTION SALE.

THE CITY FOUNDRY,
No. 388a, STAPLETON ROAD,
BRISTOL.

WILLIAM R. NURSE & SONS are instructed to SELL by AUCTION (in consequence of the dissolution of partnership), on the Premises, on

WEDNESDAY, OCTOBER 25th, 1922,

MACHINERY, BUILDINGS, AND EFFECTS.

Comprising: Drilling Machine (large type), Rumbler, Emery Wheel, Blower, Blower Fan (Lloyd's Patent), 4½-h.p. Gas Engine (Crossley), smaller Gas Engine, Gas Engine and Dynamo, TRAVELLING CRANE and GANTRY, several Moulding Box Parts, Shafting and Pulleys, DAIMLER 30-cwt. MOTOR-LORRY, in capital condition, Platform Weighing Machine (to weigh 1 ton), also large BRICK BUILDING and small ditto.

The whole will first be offered in One Lot, and the Purchaser would have the option of Renting the Premises. If not sold in One Lot will be sold separately, the Buildings to be Removed by the Purchasers.

SALE at TWO o'clock.

For further Particulars apply to the Auctioneers, 41, Nicholas Street; to EVANS & TAYLOR, Solicitors, 35, Nicholas Street, Bristol; or to WANSBROUGHS, ROBINSON, TAYLER & TAYLOR, Solicitors, Bristol, Devizes, and Melksham.

PATENTS.

ADVICE and Handbook Free.—King's Patent Agency, Limited, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

MACHINERY.

FOUNDRY SAND MIXERS (three), never been used, for 1, 2 and 4 tons per hour; clearance prices.—Box 158, Offices of the Foundry Trade Journal, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOR SALE.

Two Cross Compound Horizontal Drop Valve Engines, 12½ in. and 20 in. cylinders, 26 in. stroke, by Robey and Company, Limited. Cross Compound Horizontal Engine, 11 in. and 19 in. cylinders, 26 in. stroke, by Marshall, Sons and Company, Limited. Vertical Compound Open Type Engine, 15 in. and 22 in. cylinders, 18 in. stroke, by Browett, Lindley and Company. Vertical Compound Open Type Engine, 12 in. and 19 in. cylinders, 12 in. stroke, by Tangyes, Limited. Nearly New Surface Condensing Plant, by F. Pearn and Company, 10 in. and 16 in. steam cylinders, 12 in. stroke, surface area of tubes about 1,200 ft. Worthington Steam-Driven Jet Condensing Plant, 7½ in. and 12 in. steam cylinders, pump bucket 16 in., 12 in. stroke, 7,000 lbs. condensed steam per hour. 8 ft. Vertical Boring and Turning Mill, by J. Hetherington and Company, to take 5 ft. underneath tool boxes, two swivel tool boxes. Planing Machine, to plane 14 ft. by 5 ft. by 4 ft., two tool boxes on cross slide, by J. Buckton and Company, Limited. Multiple Punching Machine, by Rushworth and Company, capacity 33 holes–17/32 in. diameter through plates 3/16 in. thick, 3 in. pitch. 12 in. stroke Shaping Machine, quick return motion, two tables, 21 in. by 13 in. by 13 in., by Jas. Archdale and Company, Limited.

Catalogue of Stock Machinery, 5-6,000 Lots.
Free on Application. Inspection Invited.

THOS. W. WARD, LTD.,
ALBION WORKS,
SHEFFIELD.

OIL-ENGINE DRIVEN COMPRESSOR, by Blackstone, 300 lbs. pressure, 120 cubic ft. per minute, 45 h.p.; as new. 26½ kw. New Steam Generating Set, by Browett Lindley-Laurence Scott, 110 volts. 20-h.p. 220-volt Siemens Motor and Starting Panel; as new. Two nearly new Sand Mills, 32-in. pan.—Harry H. Gardam & Company, Limited, Staines.

ONE 20-in. CENTRIFUGAL FOUNDRY SAND MIXER, capacity 1 to 2 tons per hour, fitted with latest improvements and equal to new.—Price and particulars on application to C. E. V. Hall, 26, Paradise Square, Sheffield.

MISCELLANEOUS.

PENCIL GANISTER, of high quality, and other grades for Sale.—Apply, R. E. Adamson, Ushaw Moor, County Durham.

PATTERNS of Every Description, Large or Small. Let us quote you for sound, accurate, well-finished Pattern, or a cheap rough job. We can give you quick delivery at keen prices. Fully-electrically-equipped works; over 30 years' practical experience.—Walter Totty, Greenfoot Pattern Works, Old Town, Barnsley.

CUPOLAS

No. 1 GREEN CUPOLETTE with extension piece, 480-volt D.C. electric fan, starter, etc. £35
30" ALLDAYS' CUPOLA, drop bottom, excellent condition, F.O.R. £55
Blower £12 extra.

MOULDING MACHINES.

PNEUMATIC.

1 TABOR POWER SQUEEZER for boxes 26" × 26" 12" power draft .. £100
4 TABOR STANDARD TYPE, 16" × 14" POWER DRAFT SQUEEZERS each £80
2 TABOR STANDARD TYPE, 18" × 18" POWER DRAFT SQUEEZERS each £90
1 TABOR TURNOVER POWER SQUEEZER for 18" × 12" boxes .. £70
2 EVANS' DUPLEX MACHINES for 18" × 18" boxes, latest type .. .. each £90
3 JACKMAN 3" JOLTS, new condition .. .. each £28
16" TABOR PLAIN JOLT, table 6 ft. square, new .. £400

HAND.

2 "COVENTRY" HEAD RAM MACHINES by Britannia Foundry Co., new .. .. each £25
2 EVANS' FLYPRESS TYPE SQUEEZERS for 13" × 13" boxes .. .. each £12
4 TURNOVER MACHINES by Phillips for 16" × 14" boxes .. .. each £14
1 PRIDMORE ROCKOVER DROP MACHINE for 20" × 14" boxes .. £40
1 DARLING & SELLARS MACHINE, Turnover type, for 36" × 24" boxes .. £30
1 DARLING & SELLARS MACHINE, Turnover type, for 20" × 16" boxes £25

ALEX. HAMMOND, *Foundry Machinery Merchant,* **'BOXTED' SLOUGH**